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VERDIGRIS-NEOSHO RIVER BASIN

**SOUTHWEST CITY STRUCTURE
McDONALD COUNTY, MISSOURI
MO 20510**

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PHASE 1 INSPECTION REPORT NATIONAL DAM SAFETY PROGRAM



**United States Army
Corps of Engineers**
... Serving the Army
... Serving the Nation

St. Louis District

PREPARED BY: U.S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR: STATE OF MISSOURI

AUGUST, 1980

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REPLY TO
ATTENTION OF

DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT CORPS OF ENGINEERS
210 TUCKER BOULEVARD, NORTH
ST. LOUIS, MISSOURI 63101

SUBJECT: Southwest City Structure
Missouri No. 20510

This report presents the results of field inspection and evaluation
of the Southwest City Structure. It was prepared under the National
Program of Inspection of Non-Federal Dams.

SIGNED

SUBMITTED BY:

Chief, Engineering Division

8 SEP 1980

Date

SIGNED

APPROVED BY:

Colonel, CE, District Engineer

8 SEP 1980

Date

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VERDIGRIS - NEOSHO

SOUTHWEST CITY STRUCTURE
MCDONALD COUNTY, MISSOURI
MISSOURI INVENTORY NO. 20510

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Prepared By

Anderson Engineering, Inc., Springfield, Missouri
Hanson Engineers, Inc., Springfield, Illinois

Under Direction Of
St. Louis District, Corps of Engineers

For
Governor of Missouri

JULY, 1980

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM
SUMMARY

Name of Dam: Southwest City Structure
State Located: Missouri
County Located: McDonald
Stream: Tributary of Honey Creek
Date of Inspection: May 28, 1980

Southwest City Structure was inspected by an interdisciplinary team of engineers from Anderson Engineering, Inc. of Springfield, Missouri, and Hanson Engineers, Inc. of Springfield, Illinois. The purpose of this inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers, and they have been developed with the help of several Federal and State agencies, professional engineering organizations, and private engineers. Based on these guidelines, the St. Louis District, Corps of Engineers has determined that this dam is in the high hazard potential classification, which means that loss of life and appreciable property loss could occur if the dam fails. The estimated damage zone extends approximately two miles downstream of the dam. Located within this zone are approximately 20 buildings and dwellings, all in the town of Southwest City.

The dam is in the small size classification, since it is greater than 25 ft high but less than 40 ft high, and the maximum storage capacity is greater than 50 ac-ft but less than 1,000 ac-ft.

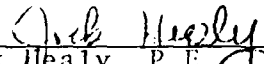
Our inspection and evaluation indicates that the combined spillways do meet the criteria set forth in the guidelines for a dam having the above size and hazard potential. The combined spillways will pass 100 percent of the Probable Maximum Flood without overtopping. The Probable Maximum Flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The guidelines require that a dam of small size with a high downstream hazard potential pass 50 to 100 percent of the PMF. Considering the height of dam (27 ft), the maximum storage capacity (152 ac-ft), and the lack of any permanent water storage, 100 percent of the PMF has been

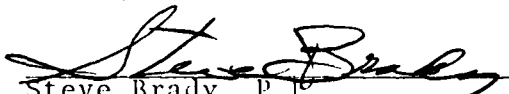
determined to be the appropriate spillway design flood. The 1 percent probability flood will not overtop the dam. The 1 percent probability flood is one that has a 1 percent chance of being exceeded in any given year.


The only deficiency visually observed by the inspection team was the presence of some small trees on the embankment of the dam.

Another deficiency was the lack of seepage and stability analysis records.

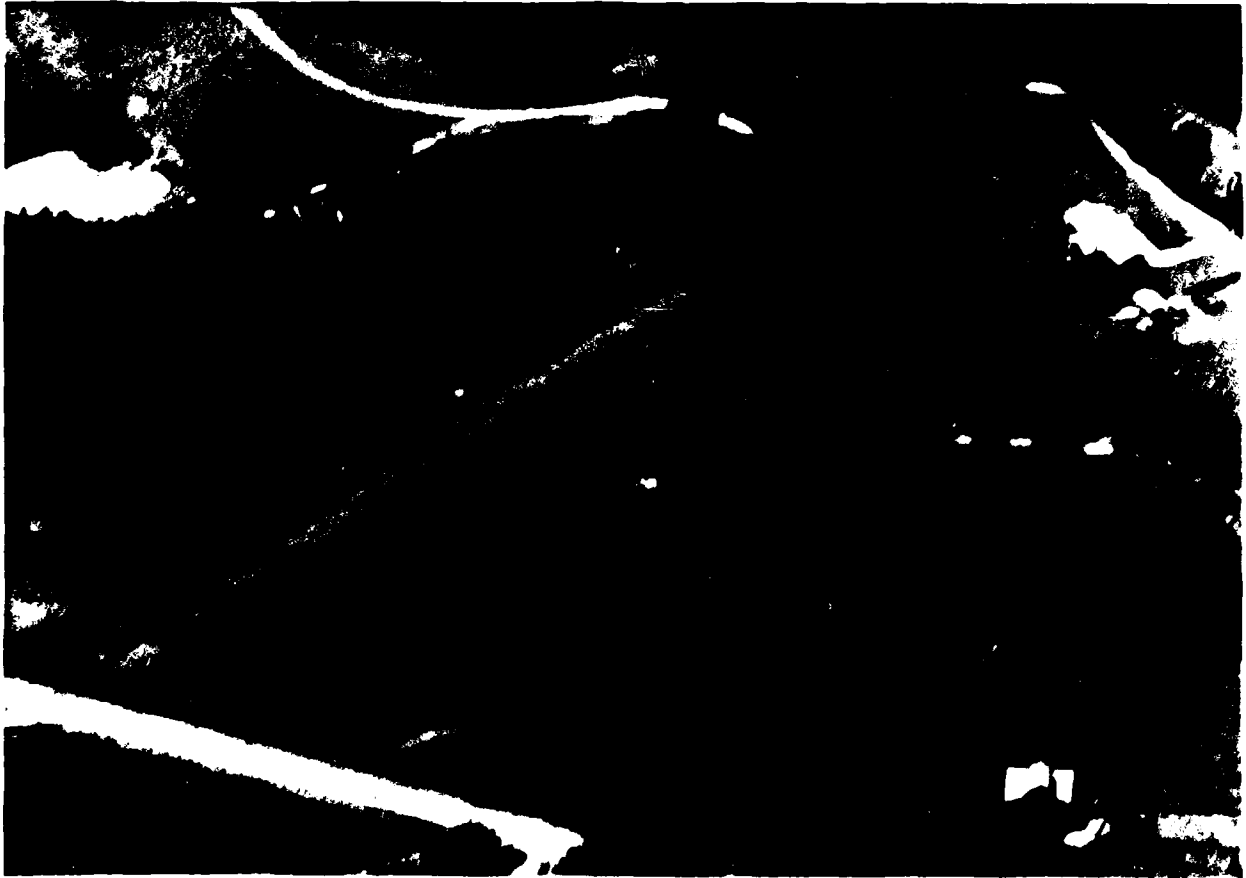
It is recommended that the owners take the necessary action without delay to correct the deficiencies reported herein. A detailed discussion of these deficiencies is included in the following report.


Jack Healy, P.E.
Hanson Engineers, Inc.


Steve Brady, P.E.
Anderson Engineering, Inc.


Nelson Morales, P.E.
Hanson Engineers, Inc.


Tom Beckley, P.E.
Anderson Engineering, Inc.



AERIAL VIEW OF LAKE AND DAM

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
SOUTHWEST CITY STRUCTURE ID NO. 20510

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SECTION 1 - PROJECT INFORMATION

1.1 GENERAL:

A. Authority.

The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the St. Louis District, Corps of Engineers, District Engineer directed that a safety inspection be made of Southwest City Structure in McDonald County, Missouri.

B. Purpose of Inspection:

The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and a visual inspection in order to determine if the dam poses hazards to human life or property.

C. Evaluation Criteria:

Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, "Recommended Guidelines for Safety Inspection of Dams, Appendix D." These guidelines were developed with the help of several federal agencies and many state agencies, professional engineering organizations, and private engineers.

1.2 DESCRIPTION OF PROJECT:

A. Description of Dam and Appurtenances.

Southwest City Structure is an earth fill structure approximately 27 ft high and 625 ft long at the crest. The appurtenant works consist of a 30 in. diameter reinforced concrete primary spillway pipe with a reinforced concrete flow riser and an earth cut swale located at the west abutment.

Sheet 3 of Appendix A shows a plan, profile, and typical section of the embankment as obtained from field inspection data. Sheets 6 through 10 of Appendix A are selected as-built drawings obtained from the U. S. Department of Agriculture, Soil Conservation Service, Columbia, Missouri.

B. Location:

The dam is located in the southwestern part of McDonald County, Missouri, on a tributary of Honey Creek. The dam and lake are within the Southwest City, Missouri, 7.5 minute quadrangle sheet (Section 33, T21N, R54W - latitude; 36°30.5'; longitude 94°37.0'). Sheet 2 of Appendix A shows the general vicinity.

C. Size Classification:

With an embankment height of 27 ft and a maximum storage capacity of approximately 152 ac-ft, the dam is in the small size category.

D. Hazard Classification:

The St. Louis District, Corps of Engineers has classified this dam as a high hazard dam. The estimated damage zone extends approximately two miles downstream of the dam. Located within this zone are approximately 20 buildings and dwellings, all in the town of Southwest City. Location of affected features within the damage zone were verified by the inspection team.

E. Ownership.

The dam is owned by Mr. Darrel Spillers. The owner's address is Southwest City, Missouri 64836.

F. Purpose of Dam:

The dam was constructed primarily for flood control as a Southwest Missouri Resource Conservation and Development Project.

G. Design and Construction History:

The dam was designed by the U. S. Department of Agriculture, Soil Conservation Service, Columbia, Missouri, under the authority of a Resource Conservation and Development Act. A partial set of as-built plans is included as Sheets 5 through 9 of Appendix A. A complete set of plans is available through the Columbia, Missouri, office of the Soil Conservation Service.

Geologic investigations and analyses completed by the Soil Conservation Service are included as Sheets 3 through 12 of Appendix B.

The contract for construction of this structure was let on May 5, 1970.

The contractor for the project was Snider Construction Company, Joplin, Missouri. Snider Construction Company was contacted for information regarding the construction. No information was available from the contractor concerning the construction history of the dam.

Inspection of the project was conducted under the control of Mr. Joe Green, Project Engineer, Soil Conservation Service, Mount Vernon, Missouri. Results of the inspection and testing, including the inspector's field notes, compaction reports, and concrete reports, are currently on file in the Columbia, Missouri, SCS office.

Mr. Green stated that the dam was built in general conformance with the plans. The only modification to the plans was the addition of the waterway berm near the principal spillway inlet structure (see Sheet 6 of Appendix A). To his knowledge, no additional changes were made to the structure.

The owner, Mr. Spillers, stated that the outlet channel of the principal spillway was sustaining considerable erosion due to the water flow. The plunge pool area was lined with car tires anchored into the salvaged concrete slab pieces placed in the plunge pool. He indicated that no further erosion problem has occurred in this area.

II. Normal Operating Procedures:

The structure was designed for flood control purposes, and no provisions for permanent water storage were made. All flows will normally be passed by the restricted flow riser to the 30 in. spillway pipe and the uncontrolled earth cut emergency spillway. Information obtained from the owner, Mr. Spillers, indicates that the dam has not been overtopped and that the maximum storage was about one half full, with the maximum time of water retained by the embankment being 12 hours. According to Mr. Spillers, the emergency spillway has not been used.

1.3 PERTINENT DATA:

Pertinent data about the dam, appurtenant works, and reservoir are presented in the following paragraphs. Sheet 3 of Appendix A presents a plan, profile, and typical section of the embankment plotted from field data obtained by the inspection team. Sheets 5 through 9 of Appendix A are selected sheets from the complete set of as-built plans prepared by the Soil Conservation Service.

A. Drainage Area:

The drainage area for this dam, as obtained from the as-built plans (Sheet 9 of Appendix A), is approximately 304 acres.

B. Discharge at Dam Site:

- (1) All discharge at the dam site is through the restricted flow riser, principal spillway, and an uncontrolled emergency spillway.
- (2) Estimated Total Spillway Capacity at Maximum Pool (Top of Dam - El. 1,004.8): 5,178 cfs

- (3) Estimated Capacity of Principal Spillway: 33 cfs
- (4) Estimated Experience Maximum Flood at Dam Site:
18 cfs at elevation 993 (estimated from owner's
information)
- (5) Diversion Tunnel Low Pool Outlet at Pool Elevation:
Not Applicable
- (6) Diversion Tunnel Outlet at Pool Elevation: Not Applicable
- (7) Gated Spillway Capacity at Pool Elevation. Not Applicable
- (8) Gated Spillway Capacity at Maximum Pool Elevation. Not
Applicable

C. Elevations:

All elevations are consistent with an assumed mean sea level elevation of 982.6 for lower invert of restricted flow riser from as-built plans for the structure.

- (1) Top of Dam: 1,004.8 ft, MSL (Low Point)
- (2) Principal Spillway Crest. 987.7 ft, MSL
- (3) Emergency Spillway Crest: 999.5 ft, MSL
- (4) Principal Outlet Pipe Invert: 979.5 ft, MSL
- (5) Streambed at Centerline of Dam: 978.0 ft, MSL
- (6) Pool on Date of Inspection: None
- (7) Apparent High Water Mark. None
- (8) Maximum Tailwater. Not Applicable
- (9) Upstream Portal Invert Diversion Tunnel: Not Applicable
- (10) Downstream Portal Invert Diversion Tunnel: Not Applicable

D. Reservoir Lengths:

- (1) At Top of Dam: 1,650 ft
- (2) At Principal Spillway Crest: 500 ft
- (3) At Emergency Spillway Crest: 1,300 ft

E. Storage Capacities:

- (1) At Principal Spillway Crest. 9.8 ac-ft
- (2) At Top of Dam: 152 ac-ft
- (3) At Emergency Spillway Crest. 87 ac-ft

F. Reservoir Surface Areas:

- (1) At Principal Spillway Crest: 3.2 acres
- (2) At Top of Dam: 13.8 acres
- (3) At Emergency Spillway Crest: 10.3 acres

G. Dam:

- (1) Type: Earth
- (2) Length at Crest: 625 ft
- (3) Height: 27 ft
- (4) Top Width: 14 ft
- (5) Side Slopes: Upstream 2.5H.1V, Downstream 2.5H.1V
- (6) Zoning: Yes, See sheet 6 of Appendix A
- (7) Impervious Core: 12 feet wide
- (8) Cutoff: 4 to 6 ft Below Base of Dam
- (9) Grout Curtain: None

H. Diversion and Regulating Tunnel:

- (1) Type: Not Applicable
- (2) Length. Not Applicable
- (3) Closure. Not Applicable
- (4) Access: Not Applicable
- (5) Regulating Facilities: Not Applicable

I. Spillway:

I.1 Principal Spillway:

- (1) Location. Centerline of Dam Station 5 + 05
- (2) Type: Uncontrolled Restricted Flow Riser and 30 in. Diameter Pipe.

I.2 Emergency Spillway.

- (1) Location. West Abutment
- (2) Type: Earth Cut

J. Regulating Outlets:

There are no regulating outlets associated with this dam.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN:

Design calculations and construction plans were prepared by and are currently on file with the Soil Conservation Service in Columbia, Missouri. A partial set of these plans is included as Sheets 5 through 9 of Appendix A. These plans were developed through the Resource Conservation and Development Act.

A. Surveys.

A topographic survey was conducted by the Soil Conservation Service for the structure area. This survey was tied to the sea level datum, and a temporary benchmark was located near the dam site. Concrete monuments were set at each end of the embankment by the Soil Conservation Service. A description of these benchmarks is shown on Sheet 5 of Appendix A.

B. Geology and Subsurface Materials.

The site is located in the border zone between the Ozarks and Western Plains geologic regions of Missouri. This area is characterized by rolling to hilly topography with oak and hickory forest areas. The sedimentary rock layers exposed in the Ozarks region dip downward away from the Ozarks region, and the higher and younger sedimentary deposits become the surface ledges in southwest Missouri. The soils in this area are residual from cherty limestones of the Agean Series of the Mississippian formations.

Soils on the site are residual cherty soils. A layer of soil on the valley floor is described as alluvial-colluvial and classified as GC in the "Detailed Geologic Investigation of Dam Sites" contained in Appendix B. Shallow probes in the embankment indicate the embankment to consist of cherty silty clays. The soils were identified by visual observation to be in the Unified Soils groups of CL and GC.

The "Geologic Map of Missouri" indicates that two series of faults exist in this area. Approximately 23 miles north of the dam are the Seneca Faults, and approximately 6 miles east is a fault line that runs northeast to southwest. These faults are considered to be inactive and have been for several million years. The publication "Caves of Missouri" indicates there are 12 caves in McDonald County, and these are several miles from the dam site with most of the caves near Pineville, Missouri.

C. Foundation and Embankment Design:

Included as Sheet 3 of Appendix B is the "Geologic Investigation of Dam Site" for this structure. The profile at the centerline of the dam shows the location of the borings as obtained by the Soil Conservation Service. Sheets 4 through 12 of Appendix B are the detailed soil investigation with conclusions from the study. Sheets 8 and 9 of Appendix B are a discussion of the results from the Soil Mechanics Laboratory of the Soil Conservation Service.

Based upon the available information, the basic foundation soil appears to be silty clay (CL). There was apparently some particular zoning of the embankment, and no internal drainage features are known to exist.

D. Hydrology and Hydraulics:

The hydrologic and hydraulic design parameters of this dam are as shown on Sheet 9 of Appendix A. Based on the as-built plans, a field check of the spillway dimensions and embankment elevations, and a check of the drainage area on U.S.G.S. quad sheets, hydrologic analyses using U. S. Army Corps of Engineers guidelines were performed. They appear as Appendix C, Sheets 1 through 9.

E. Structure:

The only structure associated with this dam is the uncontrolled restricted flow riser. Details of this riser appear as Sheet 8 of Appendix A.

2.2 CONSTRUCTION:

Inspection during the construction of the dam was performed by the Soil Conservation Service Office, Mount Vernon, Missouri, under the direction of Mr. Joe Green, Project Engineer. Mr. Green stated that daily inspection was performed during construction by members of his staff. No construction inspection data were obtained for this project. The inspector's log and inspection tests, to include compaction and concrete testing, are currently on file at the Soil Conservation Service Office, Columbia, Missouri.

2.3 OPERATION.

Normal flows would be passed by the uncontrolled restricted flow riser to the 30 in. spillway pipe and the uncontrolled earth cut emergency spillway.

2.4 EVALUATION.

A. Availability:

The engineering data available are as listed in Section 2.1.

B. Adequacy.

The engineering data available is adequate to prepare a base for a detailed assessment of the design, construction, and operation of this structure. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.

C. Validity:

The as-built plans and design data prepared by the Soil Conservation Service and included in Appendices A and B are valid engineering data on the design and construction of the dam.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS:

A. General.

The field inspection was made on May 28, 1980. The inspection team consisted of personnel from Anderson Engineering, Inc. of Springfield, Missouri and Hanson Engineers, Inc. of Springfield, Illinois. The team members were:

Jack Healy, P.E., Hanson Engineers, Inc., (Geotechnical Engineer)
Steve Brady, P.E., Anderson Engineering, Inc., (Civil Engineer)
Nelson Morales, P.E., Hanson Engineers, Inc., (Hydraulic Engineer)
Tom Beckley, P.E., Anderson Engineering, Inc., (Civil Engineer)

Photographs of the dam, appurtenant structures, reservoir, and downstream features are presented in Appendix D.

B. Dam.

The dam embankment appears to be in good condition. No sloughing or sliding of the embankment was noted. The horizontal and vertical alignments of the crest were good. No surface cracking or unusual movements were obvious. The crest of the embankment was 14 ft wide, the low crest elevation was 1,004.8; the high crest elevation was 1,005.5. The field survey data obtained by the inspection team compared favorably to the as-built plans for the structure.

Shallow auger probes into the embankment indicated the fill material to be a reddish-brown silty clay (CL). The embankment is grass-covered and appears to be in good condition. Some small trees (3 to 4 ft high) were noted, primarily on the downstream embankment face. No sloughing of the embankment or seepage through the embankment was evident. No animal burrows were noted. No serious erosion was observed.

No water was stored behind the embankment on the date of inspection. As a facility for floodwater retention, no permanent water storage is planned. The restricted flow riser has an inlet at the bottom and 5 ft above the bottom with no means of permanently retaining water.

No instrumentation (monuments, piezometers, etc.), including the benchmarks noted on Sheet 5 of Appendix A; was observed.

C. Appurtenant Structures:

C.1 Principal Spillway:

The principal spillway consisting of the 30 in. diameter reinforced concrete pipe and associated flow restrictor riser appeared

to be in good condition. The normal flow is through the uncontrolled riser orifices. One is located at the bottom of the riser, and the other is 5 ft above the bottom of the riser.

The approach to the inlet structure was clear with good grass cover. No noticeable erosion around the inlet was observed. The spillway outlet was clear with evidence of past erosion problems. The plunge pool area was lined with car tires and broken pieces of concrete. The remedial measure of lining the plunge pool area appears to have minimized channel erosion.

C.2 Emergency Spillway.

The emergency spillway, located at the west abutment, was an earth cut channel. The grass cover in the channel was good with no noticeable erosion. According to Mr. Spillers, the emergency spillway has never been used.

The outlet channel is directed well away from the embankment. The inlet and outlet to the channel were clear.

D. Reservoir.

The reservoir area was generally pastureland with good grass cover. The slopes to the reservoir were moderate. The reservoir banks appeared to be in good condition with no noticeable sedimentation.

E. Downstream Channel:

The downstream channel slopes, extending from the dam to the town of Southwest City, are classified as gently rolling slopes.

3.2 EVALUATION:

The embankment of the dam appears to be good with heavy grass cover. No noticeable erosion was observed on the embankment slopes or the emergency spillway. The prior erosional area at the primary spillway outlet appears to have been corrected and is checking the erosion of the plunge pool area.

Some light brush and small trees were noted on the downstream slope of the embankment.

Photographs of the dam, appurtenant structures, and the reservoir are presented in Appendix D.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES:

The operation and maintenance of the dam are the responsibility of the Southwest Missouri Resource Conservation and Development Executive Committee, City of Southwest City, Missouri, in conjunction with the Soil and Water Conservation District of McDonald County, Missouri. For the first three years following construction of the dam, a joint inspection was conducted by members of the Executive Committee and the Soil Conservation Service. After the three year time period, the responsibility was assumed by the Executive Committee. In addition to the required annual inspection, the dam is to be inspected after each severe flood and after the occurrence of any other unusual condition which might adversely affect the structure.

The inspection is to include the condition of the primary spillway and its appurtenances, the emergency spillway, the earthfill, and any other items installed as a part of the structure. Copies of the inspection report are forwarded to the Soil Conservation Service office in Springfield, Missouri. The last annual inspection of record was in July of 1978. The results of this inspection are included as Sheet 10 of Appendix A.

4.2 MAINTENANCE OF DAM.

After the annual inspection of the dam, the Executive Committee determines the maintenance to be done. Money for the required maintenance is derived from a tax levy imposed upon the residents of the watershed district.

4.3 MAINTENANCE OF OPERATING FACILITIES:

The maintenance required for the restricted flow riser is accomplished after the annual inspection by the Executive Committee.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT:

The inspection team is unaware of any existing warning system for this dam.

4.5 EVALUATION:

The general maintenance of the dam and associated items appeared to be in good condition. Some small brush growth was observed on the downstream slope of the embankment. The grass cover on the embankment and emergency spillway channel was good.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES:

The operation and maintenance of the dam are the responsibility of the Southwest Missouri Resource Conservation and Development Executive Committee, City of Southwest City, Missouri, in conjunction with the Soil and Water Conservation District of McDonald County, Missouri. For the first three years following construction of the dam, a joint inspection was conducted by members of the Executive Committee and the Soil Conservation Service. After the three year time period, the responsibility was assumed by the Executive Committee. In addition to the required annual inspection, the dam is to be inspected after each severe flood and after the occurrence of any other unusual condition which might adversely affect the structure.

The inspection is to include the condition of the primary spillway and its appurtenances, the emergency spillway, the earthfill, and any other items installed as a part of the structure. Copies of the inspection report are forwarded to the Soil Conservation Service office in Springfield, Missouri. The last annual inspection of record was in July of 1978. The results of this inspection are included as Sheet 10 of Appendix A.

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4.5 EVALUATION:

The general maintenance of the dam and associated items appeared to be in good condition. Some small brush growth was observed on the downstream slope of the embankment. The grass cover on the embankment and emergency spillway channel was good.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES:

A. Design Data:

The hydrologic and hydraulic design data for this dam are as shown on Sheet 9 of Appendix A.

B. Experience Data:

No recorded rainfall, runoff, discharge, or reservoir stage data were available for this lake and watershed.

C. Visual Observations:

The approach channels to the spillway are clear. The emergency spillway is well separated from the embankment. Spillway releases would not be expected to endanger the dam. The prior erosion of the principal spillway outlet appears to have been satisfactorily repaired and checked.

D. Overtopping Potential:

The hydraulic and hydrologic analyses (using the U. S. Army Corps of Engineers guidelines and the HEC-1 computer program) were based on: (1) a field survey of spillway dimensions and embankment elevations; (2) an estimate of the reservoir storage and the pool and drainage areas from the Southwest City, Missouri, Colcord NE, Arkansas, Oklahoma, Missouri, Sycamore, Oklahoma, and Dodge, Oklahoma, 7.5 Minute U.S.G.S. quad sheets; and (3) data obtained from the as-built plans prepared by the Soil Conservation Service.

Based on the hydrologic and hydraulic analysis presented in Appendix C, the combined spillways will pass 100 percent of the Probable Maximum Flood. The Probable Maximum Flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The recommended guidelines from the Department of the Army, Office of the Chief of Engineers, require that this structure (small size with high downstream hazard potential) pass 50 percent to 100 percent of the PMF, without overtopping. Considering the height of dam (27 ft), the maximum storage capacity (152 ac-ft), and the lack of any permanent water storage, 100 percent of the PMF has been determined to be the appropriate spillway design flood. The spillways will pass a 1 percent probability flood without overtopping the dam.

Application of the probable maximum precipitation (PMP), minus losses, resulted in a flood hydrograph peak inflow of 5,211 cfs. For 100 percent of the PMP, the peak inflow was 2,605 cfs.

The routing of the PMF through the spillways and dam indicates that the dam will not be overtopped. The maximum outflow will be 4,794 cfs. The maximum discharge capacity of the spillways is 5,178 cfs.

SECTION 6 STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY.

A. Visual Observations.

Observed features which could adversely affect the structural stability of this dam are discussed in Sections 3.1B and 3.2.

B. Design and Construction Data:

Design data obtained are included in Appendix A. Analysis of the soil structure is included in Appendix B. Additional design data and construction notes and tests are located at the Soil Conservation Service in Columbia, Missouri.

Seepage and stability analyses comparable to the requirements of the guidelines were not available, which constitutes a deficiency which should be rectified.

C. Operating Records.

No operating records have been obtained.

D. Post Construction Changes:

To our knowledge, no post-construction changes have been made.

E. Seismic Stability:

The structure is located in seismic zone 2. An earthquake of this magnitude would not generally be expected to cause severe structural damage to a well constructed earth dam of this size. However, it is recommended that the prescribed seismic loading for this zone be applied in stability analyses performed for this dam.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT:

This Phase I inspection and evaluation should not be considered as being comprehensive since the scope of work contracted for is far less detailed than would be required for an in-depth evaluation of dams. Latent deficiencies, which might be detected by a totally comprehensive investigation, could exist.

A. Safety:

The embankment is in good condition. An item noted during the visual inspection which should be corrected or controlled is the presence of some small trees on the embankment of the dam.

Another deficiency was the lack of seepage and stability analyses records.

The combined spillways will pass 100 percent of the PMF without overtopping. Overtopping of an earthen embankment could cause serious erosion and could possibly lead to failure of the structure.

B. Adequacy of Information:

The conclusions in this report were based on review of the information listed in Section 2.1, the performance history as related by others, and visual observation of external conditions. The inspection team considers that these data are sufficient to support the conclusions herein. Seepage and stability analyses comparable to the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

C. Urgency:

The remedial measures recommended in paragraph 7.2 should be accomplished in the near future. If the deficiencies listed in paragraph A are not corrected, and if good maintenance is not provided, the embankment condition will deteriorate and possibly could become serious in the future.

D. Necessity for Additional Inspection:

Based on the result of the Phase I inspection, no additional inspection is recommended.

E. Seismic Stability.

The structure is located in seismic zone 2. An earthquake of this magnitude would not generally be expected to cause severe structural damage to a well constructed earth dam of this size. However, it is recommended that the prescribed seismic loading for this zone be applied in any stability analyses performed for this dam.

7.2 REMEDIAL MEASURES:

The following remedial measures and maintenance procedures are recommended. All remedial measures should be performed under the guidance of a professional engineer experienced in the design and construction of dams.

A. Alternatives:

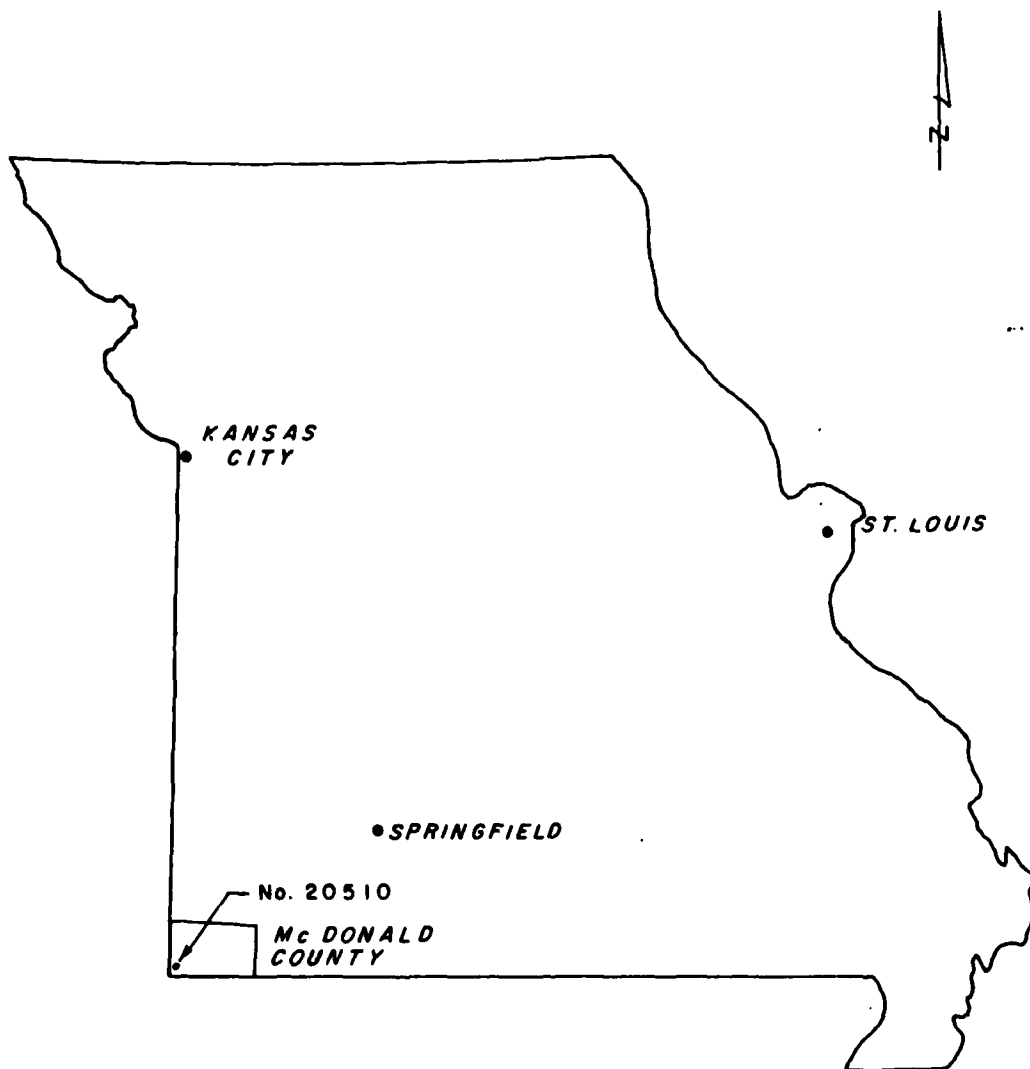
- (1) Not Applicable

B. O & M Procedures:

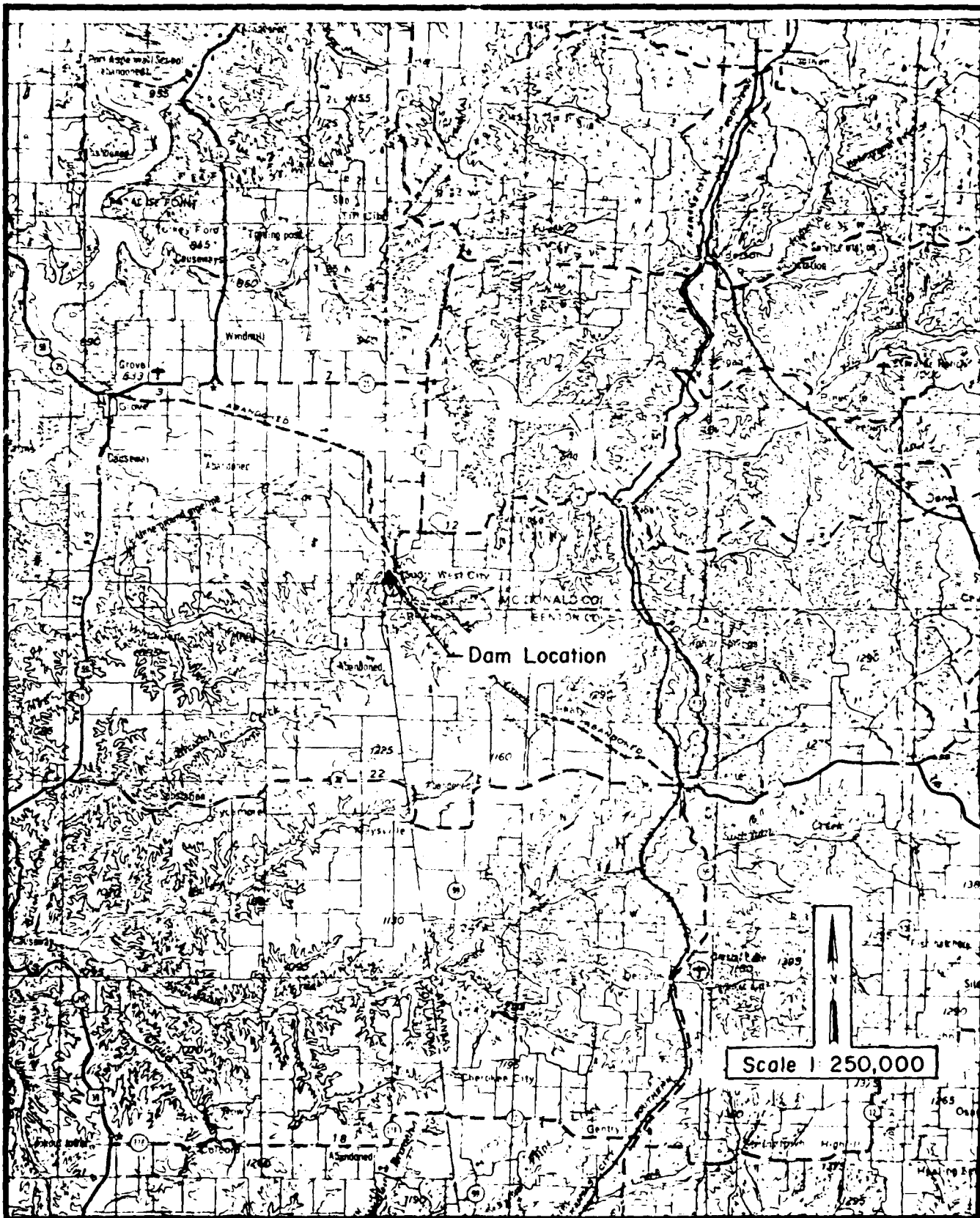
- (1) Seepage and stability analyses comparable to the requirements of the recommended guidelines should be performed by an engineer experienced in the construction of dams.
- (2) The small tree growth on the embankment face should be removed, and the vegetative growth on the dam should be cut annually.
- (3) A detailed inspection of the dam should be made periodically by an engineer experienced in the design and construction of dams.

APPENDIX A

Dam Location and Plans



LOCATION MAP



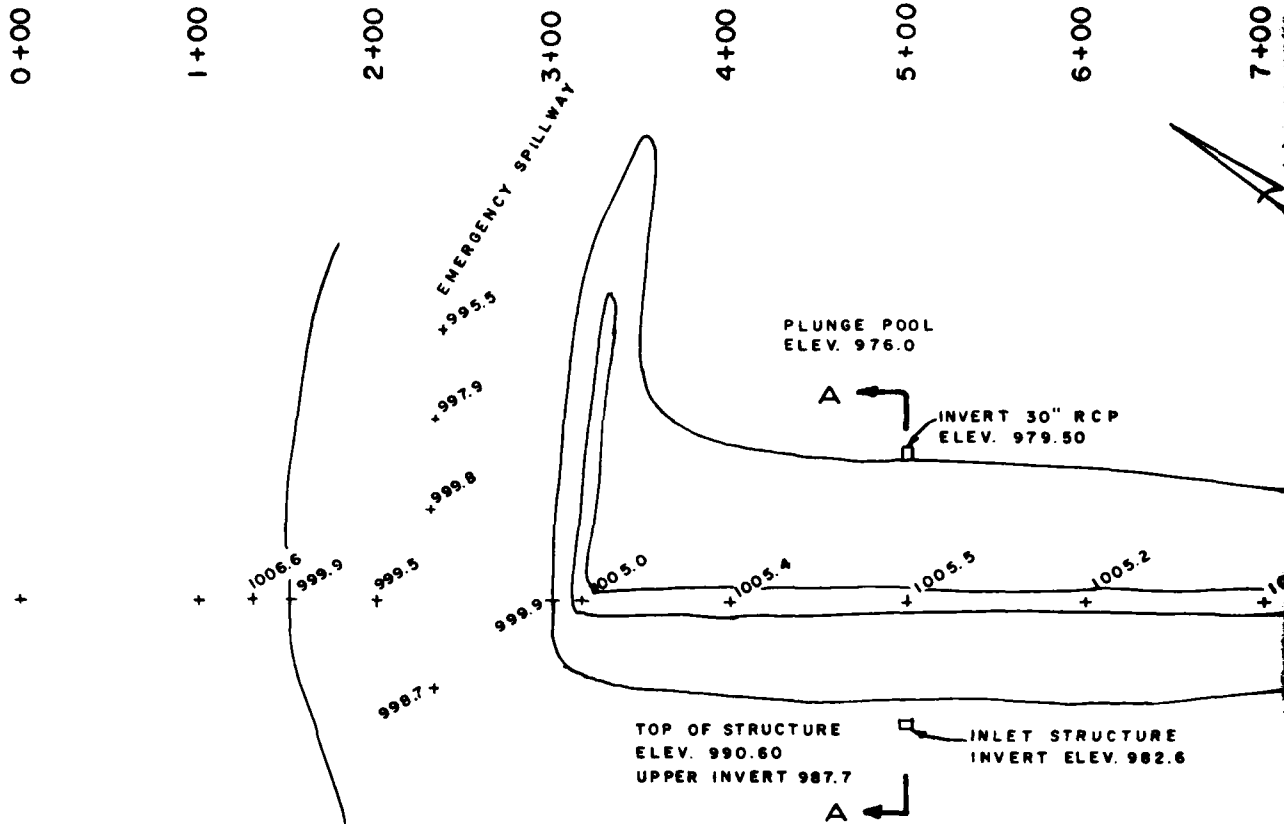
VICINITY MAP



SPRINGFIELD, IL • PEORIA, IL • ROCKFORD, IL

South West City Structure E-1 Dam
McDonald County, Missouri
Mo. I.D. No 20510

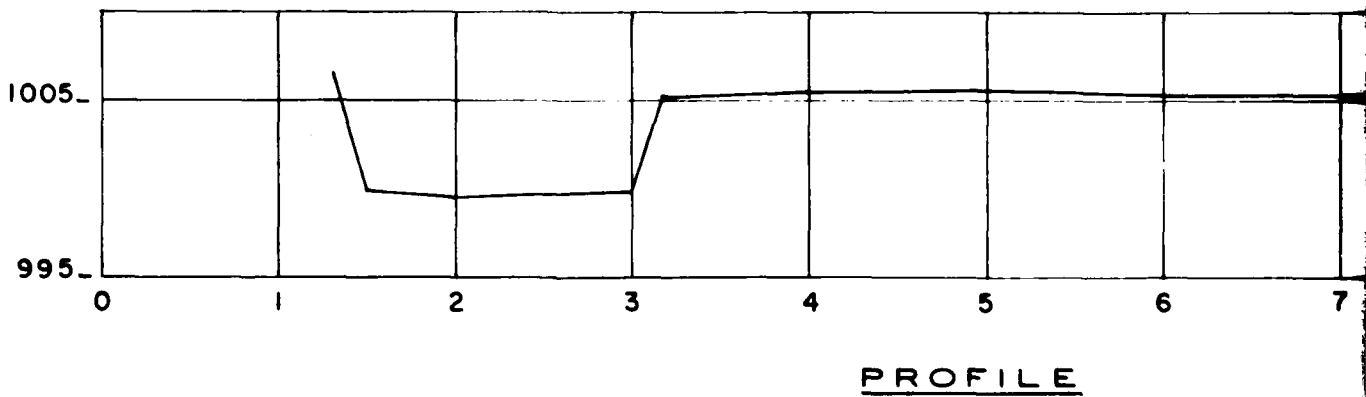
Sheet 2 , Appendix A



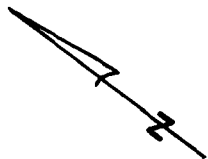
POOL

PLAN VIEW

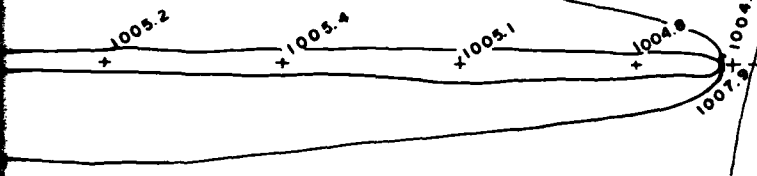
SCALE: 1" = 100'



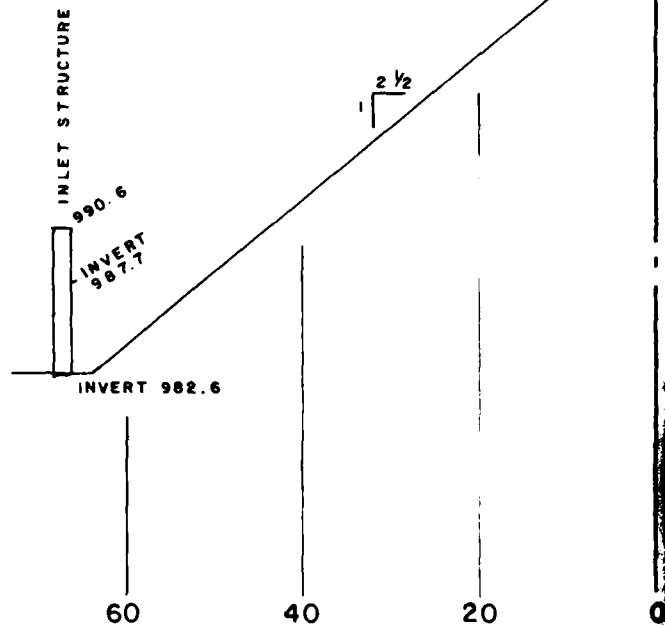
6+00 7+00 8+00 9+00



12" 30" RCP
979.50

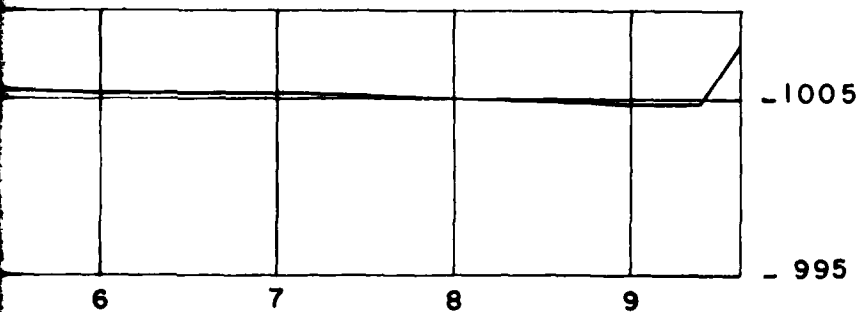


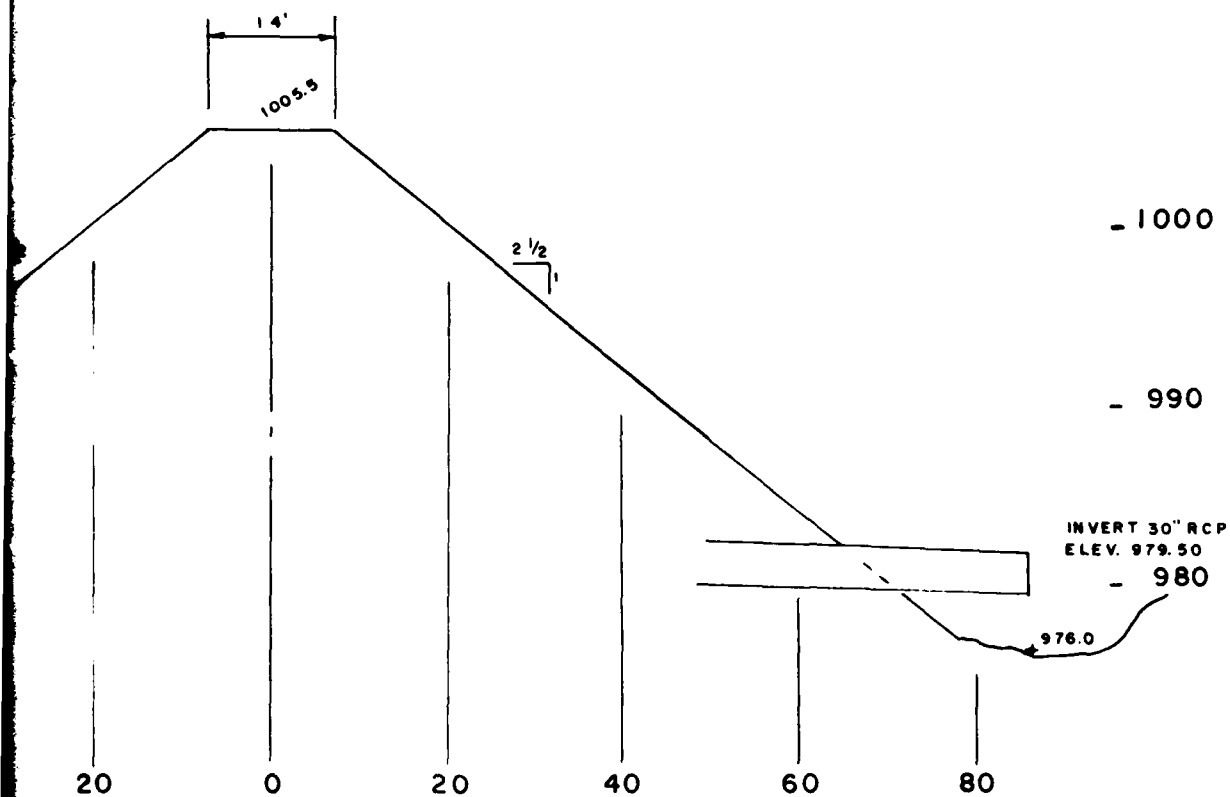
INLET STRUCTURE
INVERT ELEV. 982.6



SECTION

VIEW
= 100'





SECTION A-A STA 5+00

SHEET 3 APPENDIX A

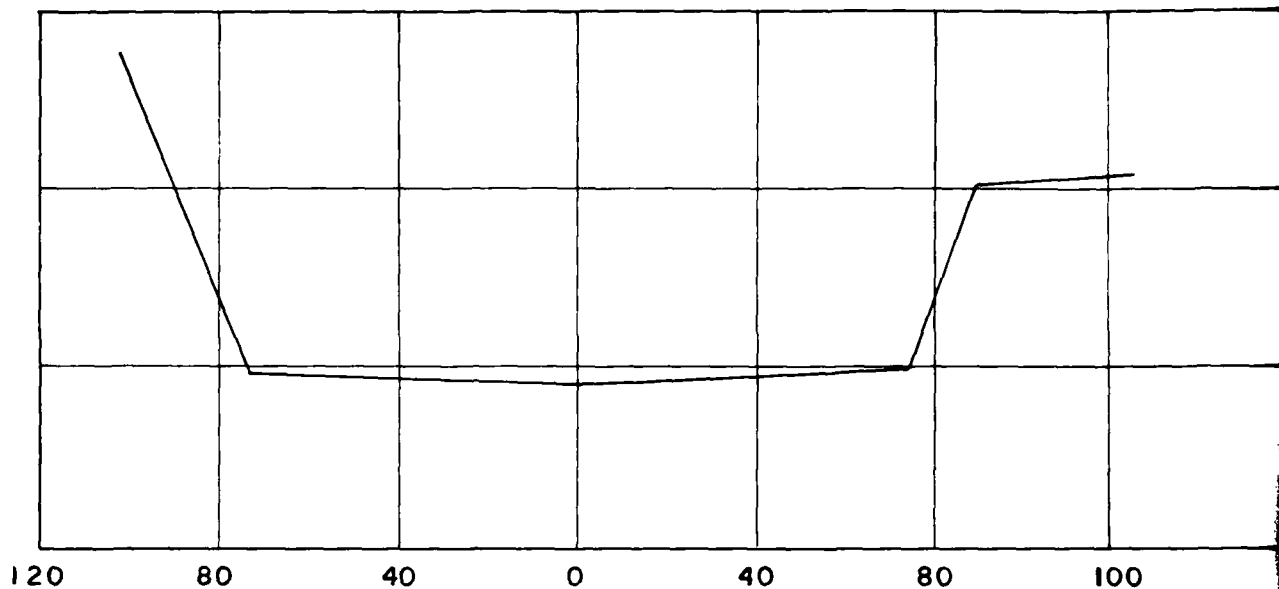
ANDERSON ENGINEERING, INC.
730 NORTH BENTON AVENUE
SPRINGFIELD, MISSOURI 65802

SOUTHWEST CITY
STRUCTURE E-1
MO. No. 20510

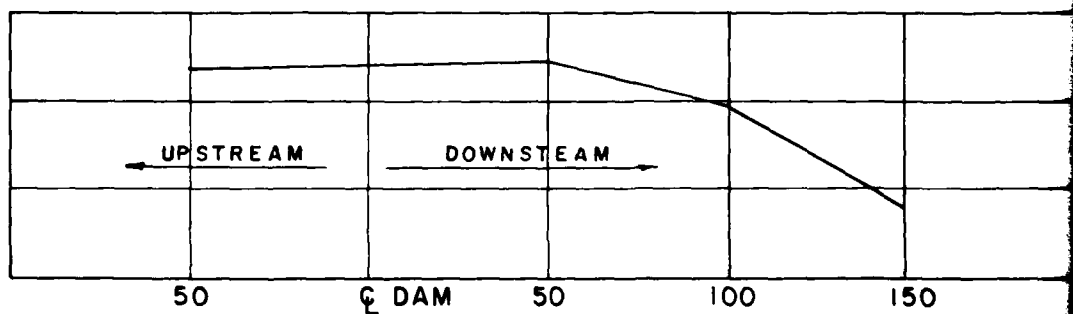
PLAN & PROFILE

MCDONALD COUNTY, MO.

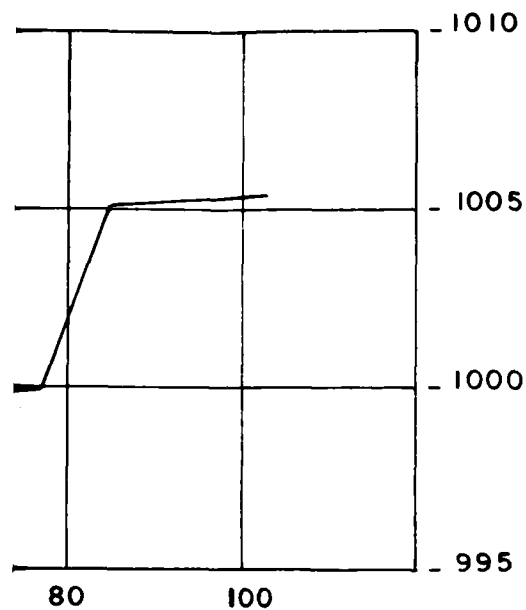
13



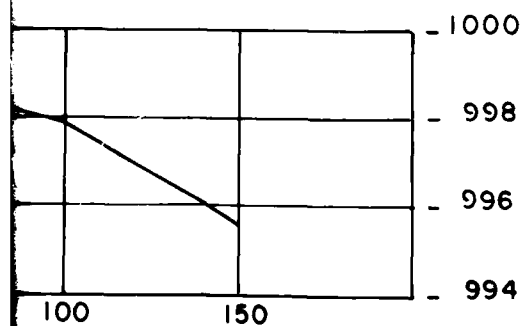
SPILLWAY SECTION & DAM



SPILLWAY PROFILE



DAM



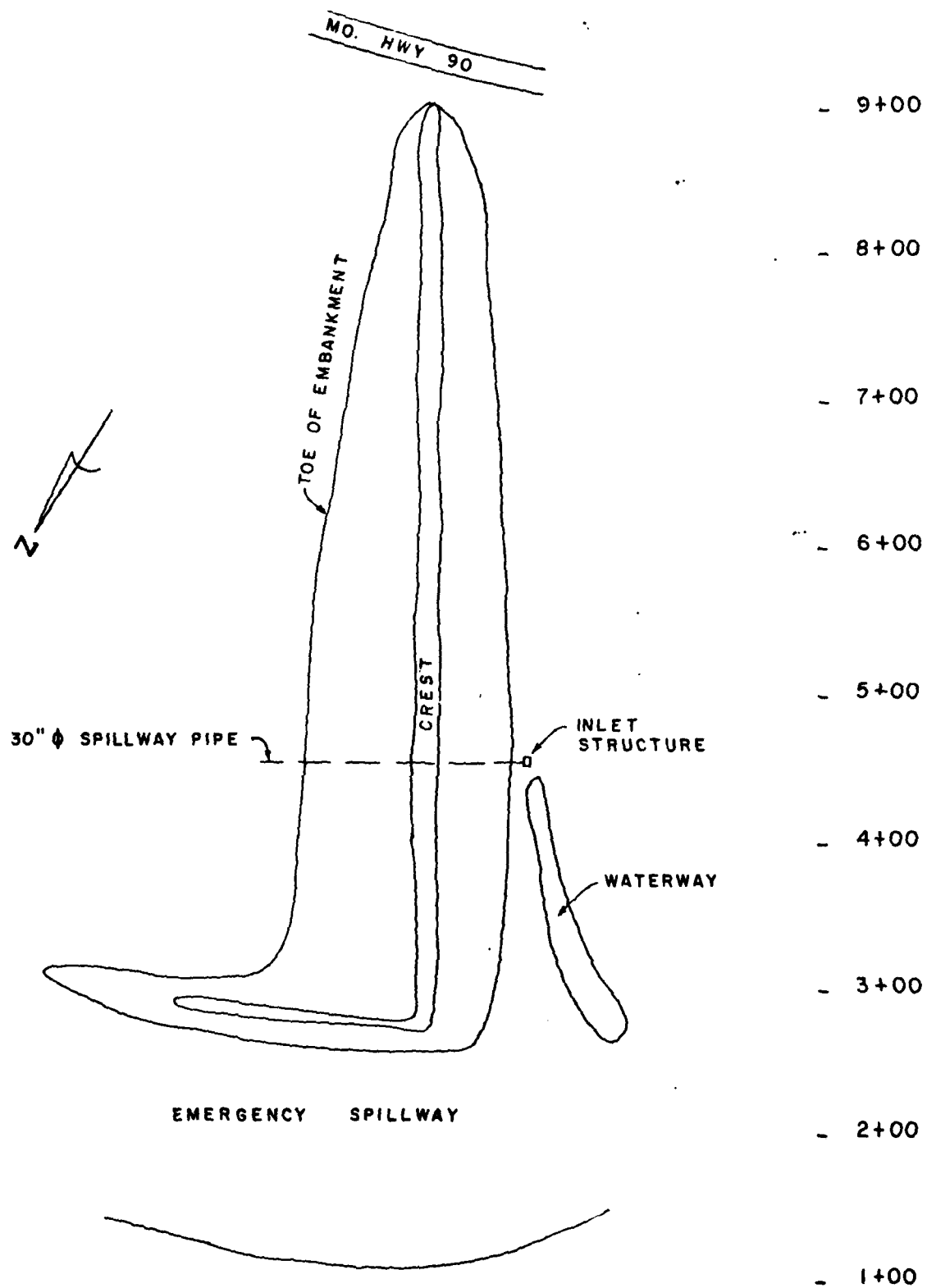
FILE

SHEET 3A APPENDIX A

ANDERSON ENGINEERING, INC.
730 NORTH BENTON AVENUE
SPRINGFIELD, MISSOURI 65802

SOUTHWEST CITY
STRUCTURE E-1
MO. No. 20510

SPILLWAY
SECTION & PROFILE
McDONALD COUNTY, MO.



PLAN SKETCH OF DAM
SOUTHWEST CITY STRUCTURE
MO. No. 20510

DARRELL SPILLERS

ARTHUR C CULVER

P.B.M. #1 Elev. 1024.26 - Top of bronze cap on Concrete Monument Sta 0+00 of Dam

P.B.M. #2 Elev. 1004.93 - Top of bronze cap on Concrete Monument Sta 9+31.25 of Dam

T.B.M. #2 Elev. 1006.00 - Top 60d spike set in root of 36" Oak Tree.

DATA TABLE

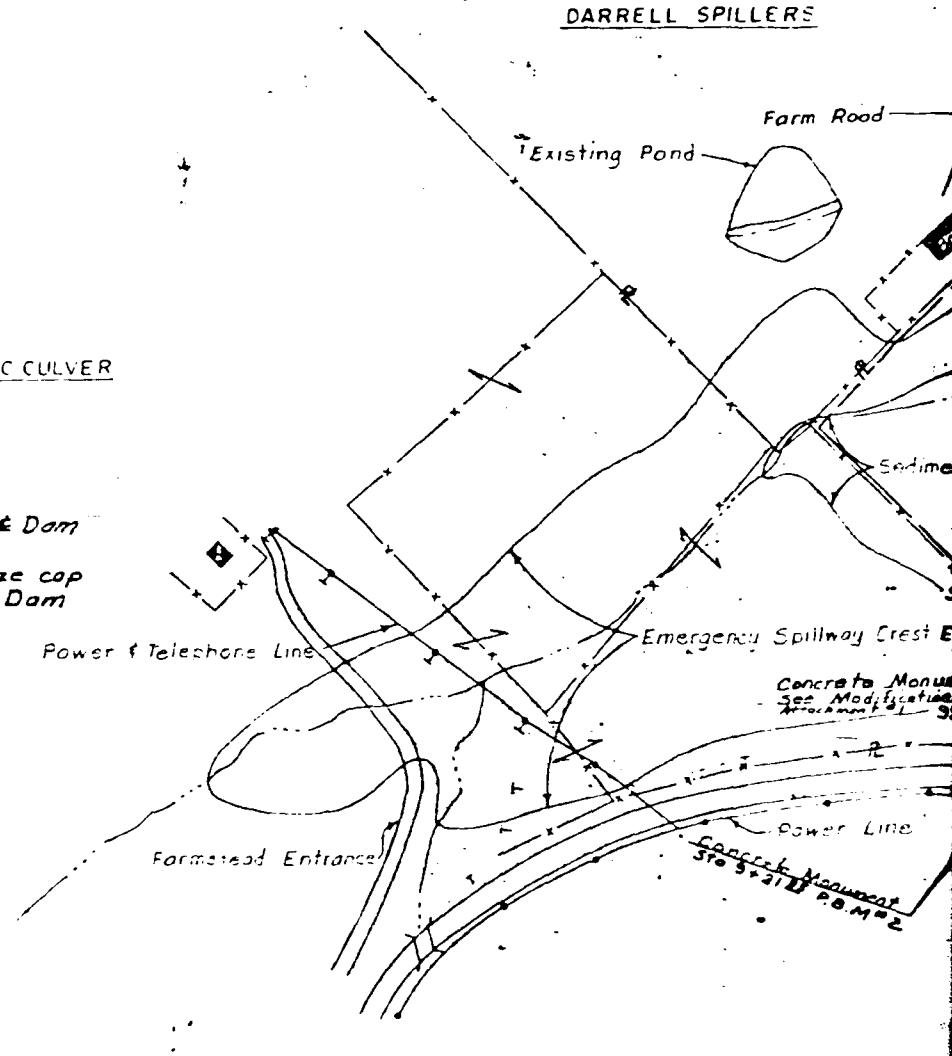
Drainage Area, Acres	304
Reservoir Storage Area, Feet-Feet	9.5
Reservoir Storage Area, Feet	77.1
Reservoir Area, Acres (Dry Con)	31
Reservoir Area, Acres	10.3

Southwest City Structure located approx 1/2 mile south of Southwest City, Mo. in Sec. 33 Twp. 21N, R. 34W

~~21N, R. 34W, Sec. 33~~
~~Southwest City Structure~~
~~Destroyed~~

QUANTITIES

Closing & Grubbing 200 Lums Sec.
 (Approx. 2 Acres)



GENERAL PLAN OF RESERVOIR

Scale in feet
 0 50 100 200

OKLAHOMA
MISSOURI

DARRELL SPILLERS

Farm Road

Existing Pond

South Street

Approx Work Limits

Fence to be removed

Concrete Monument
Sta 0+00 P.B.M. #2

Emer Spwy

Closed Well
Hand-dug Wells
(To Be Removed)

Approx. Clearing & Grubbing Limits

WALLACE C WILKERSON

Sediment Pool Elev 6+00

Dam

Emergency Spillway Crest Elev 987.6

Concrete Monument
Sta 0+00 P.B.M. #2

Property Line Fence

Telephone Line

Gate Destroyed

Power Line

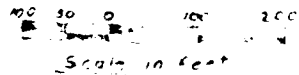
MO. STATE HIGHWAY 90

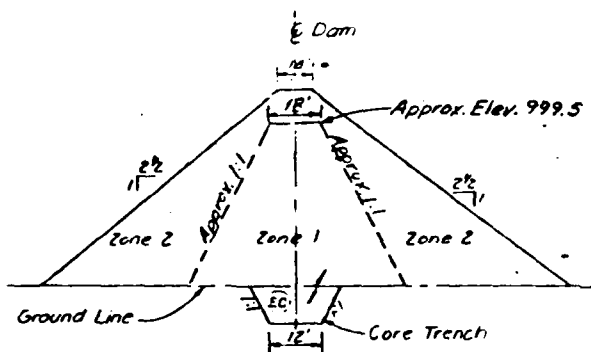
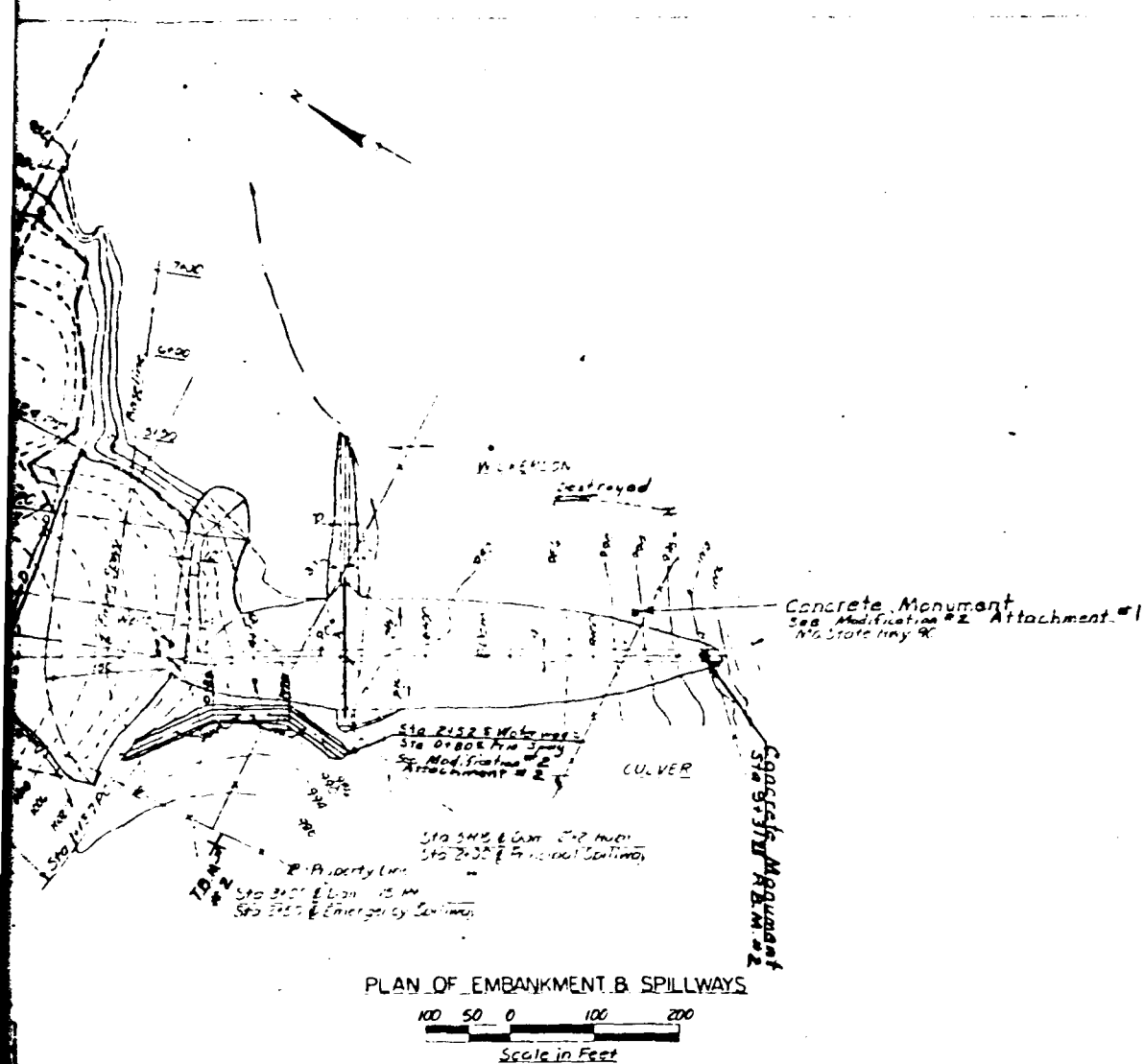
AS BUILT

SOUTHWEST CITY STRUCTURE
SOUTHWEST MISSOURI R.C.S.D. PROJECT
MCDONALD COUNTY, MISSOURI

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GENERAL PLAN OF RESERVOIR





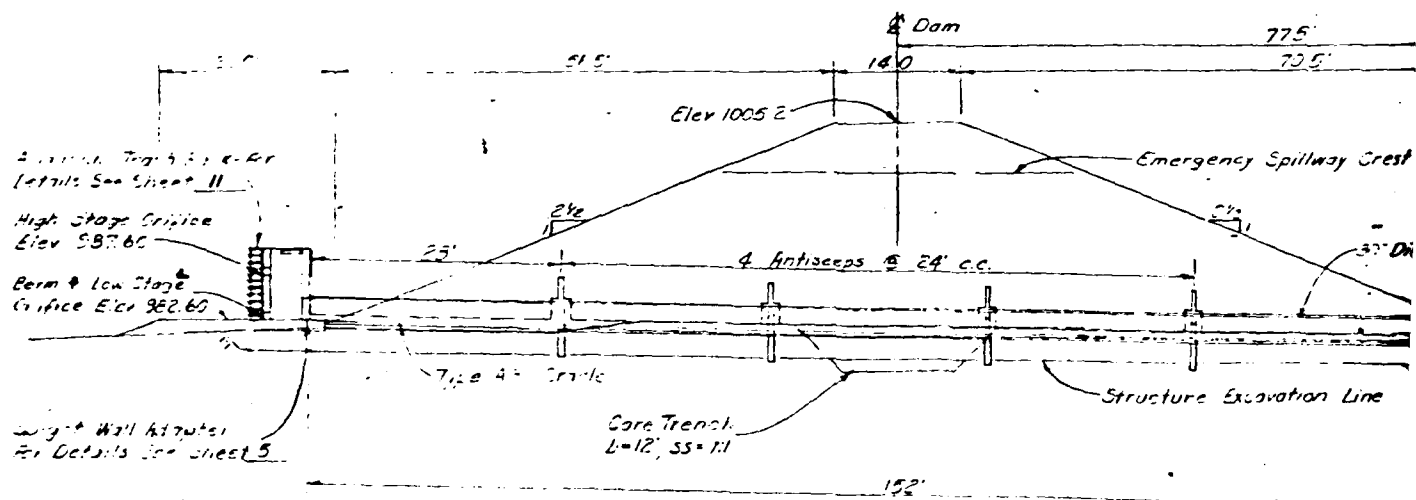
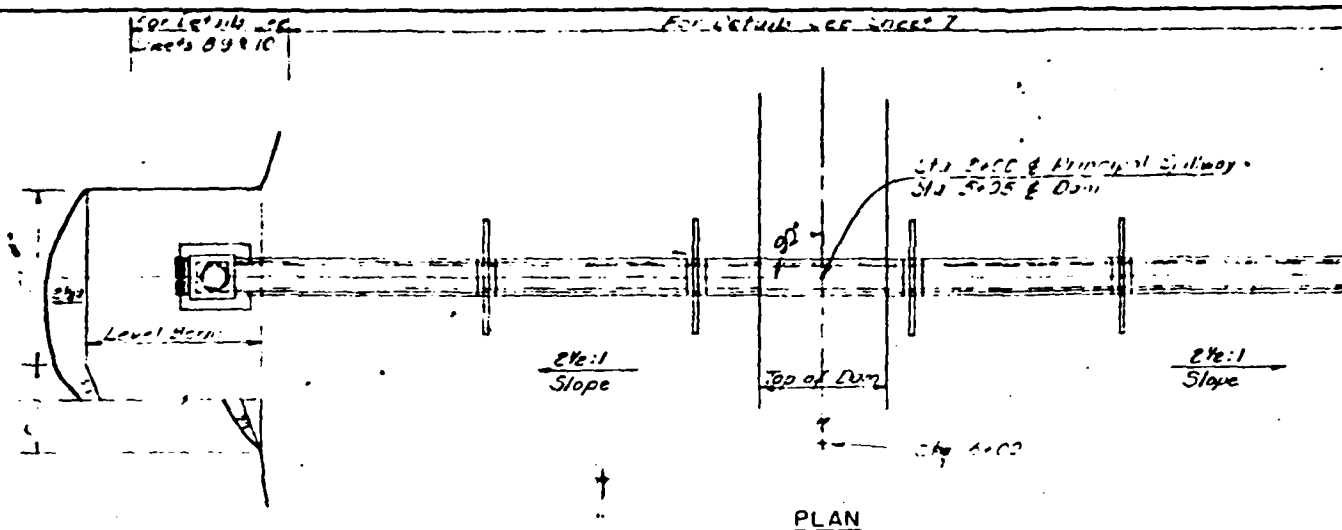
QUANTITIES	
Excavation, Common	
Structure	587 Cu Yds
Outlet Channel	369 Cu Yds
Core Trench	1366 Cu Yds
Total	2,322 Cu Yds
Earth Fill, Class A	
Zone 1	18,178 Cu Yds
Zone 2	18,178 Cu Yds
Total	36,356 Cu Yds
Topsoil	18,178 Sq Yds
Waterway Improvement - Lump Sum	
Concrete Monument - Lump Sum	

AS BUILT

SOUTHWEST CITY STRUCTURE
SOUTHWEST MISSOURI RC&D. PROJECT
MCDONALD COUNTY, MISSOURI

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

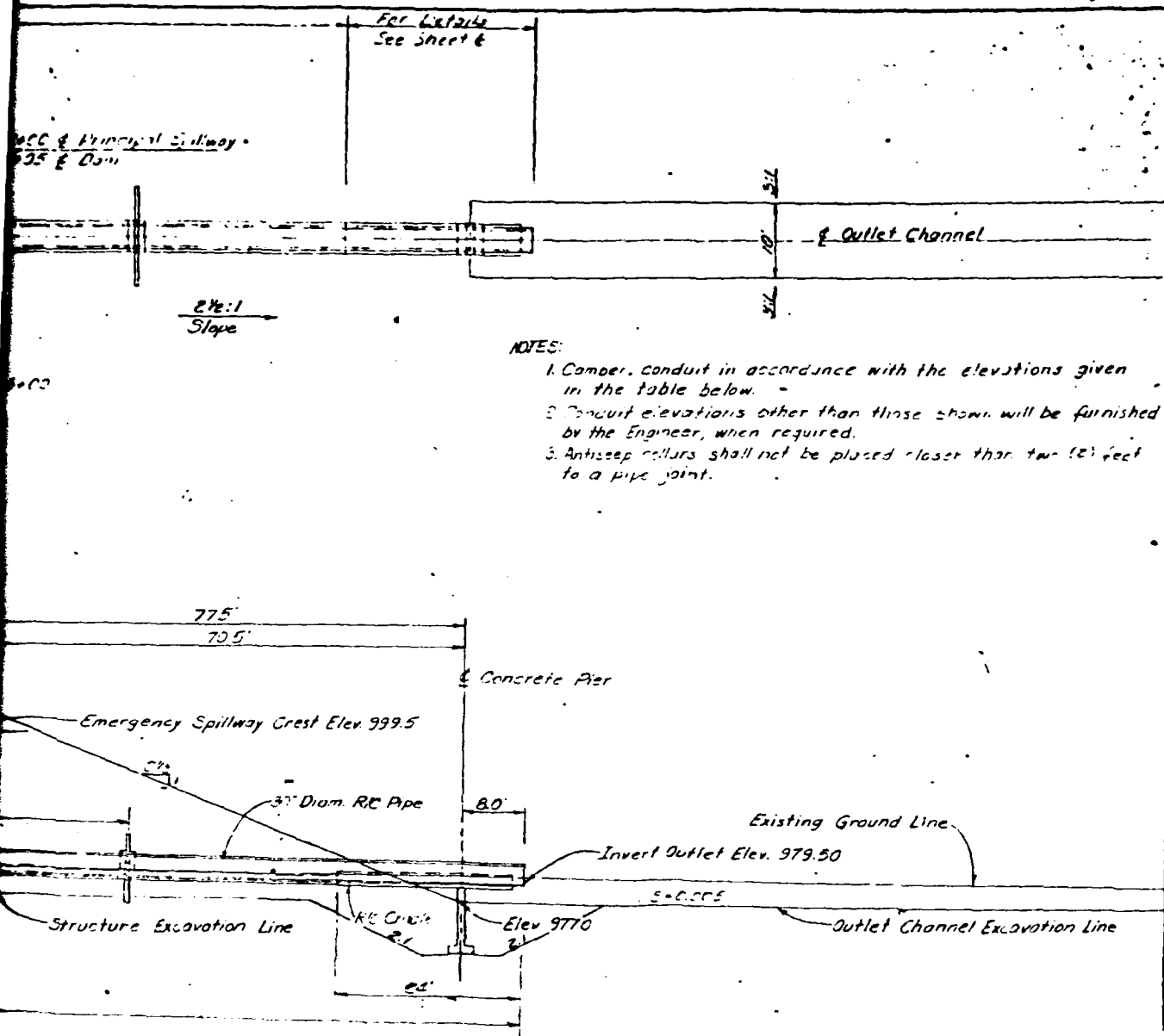
Designed	RWK & JAG	9-62	Approved By	
Drawn	M.D.H.	10-62	Checked	
Reviewed			Reviewed By	
Location	BES & RNC	10-69	Scale	3/4" = 1'
			Sheet	51-27,741



PIPE NUMBER	
STATION	ELEVATION
0	979.90
16	
24	979.99
40	980.62
56	980.99
72	981.42
88	981.79
104	982.07
120	982.30
136	982.47
152	982.60

QUANTITIES

Concrete - Class 2500, Plain
 Concrete - Class 4750, Reinforced
 Steel Bar Reinforcement
 Fill (concrete) Reinforced Concrete (Pressure: 30' Dam, Steel Ring Type Joint and Aluminum Trash Rack



NOTES:

1. Camber conduit in accordance with the elevations given in the table below.
2. Conduit elevations other than those shown will be furnished by the Engineer, when required.
3. Antiseep collars shall not be placed closer than two (2) feet to a pipe joint.

QUANTITIES

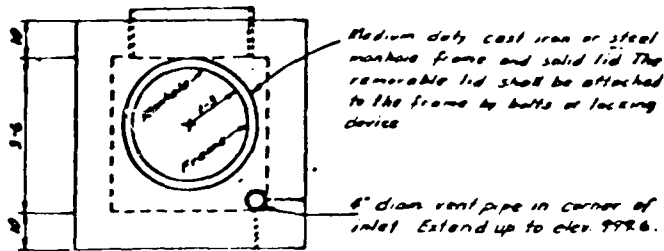
21.5 Cu. Yds.
22.7 Cu. Yds.
2205 Pounds
152 Lin. Ft.
Lump Sum

AS BUILT

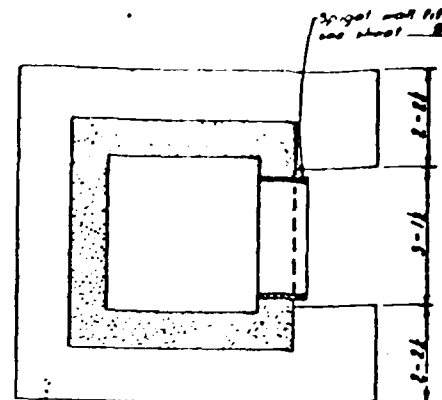
SOUTHWEST CITY STRUCTURE

RESTRICTED FLOW INLET FOR 30" DIAM PIPE
GENERAL LAYOUT
SOUTHWEST MISSOURI R.C.B.D. PROJECT
MCDONALD COUNTY, MISSOURI
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed R.W.R.	9-63	Drawn By	
Drawn B.C.S.	9-69	Checked By	
Field		Field	
Constr. R.W.R. & R.H.H.	10-67	Constr. By	58-17741



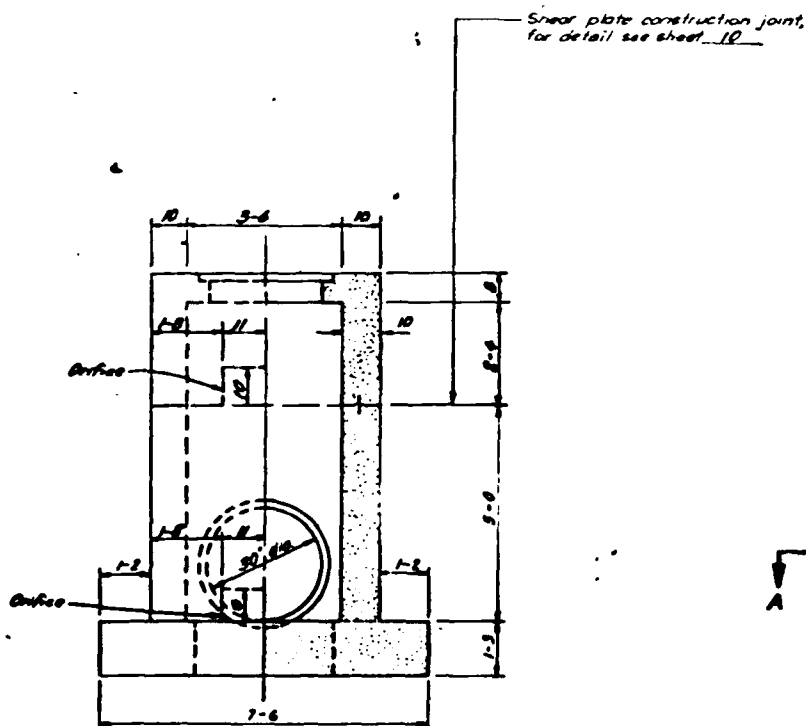
TOP PLAN



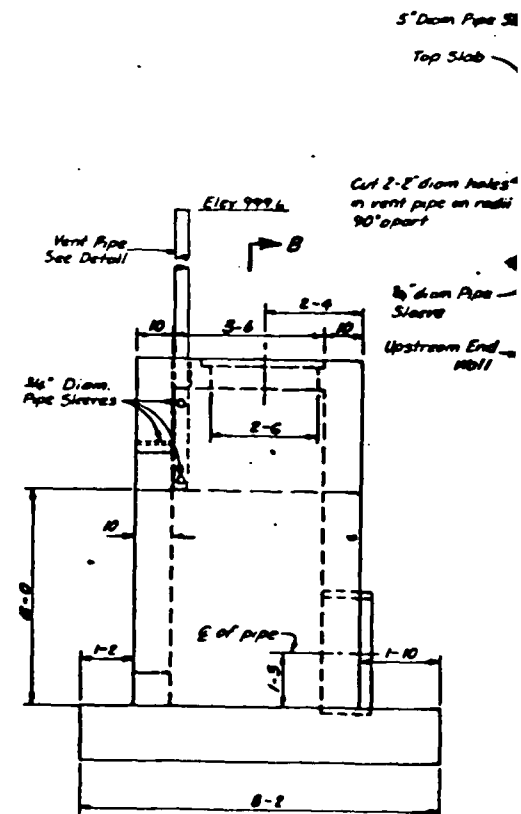
SECTION A-A

Quantity	Unit
1	ft
1	ft
3	ft
3	ft

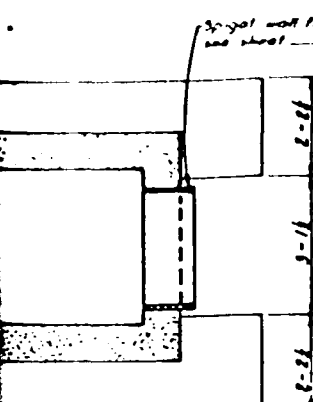
- 1 Chamfer all exposed edges $\frac{3}{8}$ "
 2 For Trash Rack details see Sheet 11.



HALF UPSTREAM ENDWALL HALF SECTION B-B



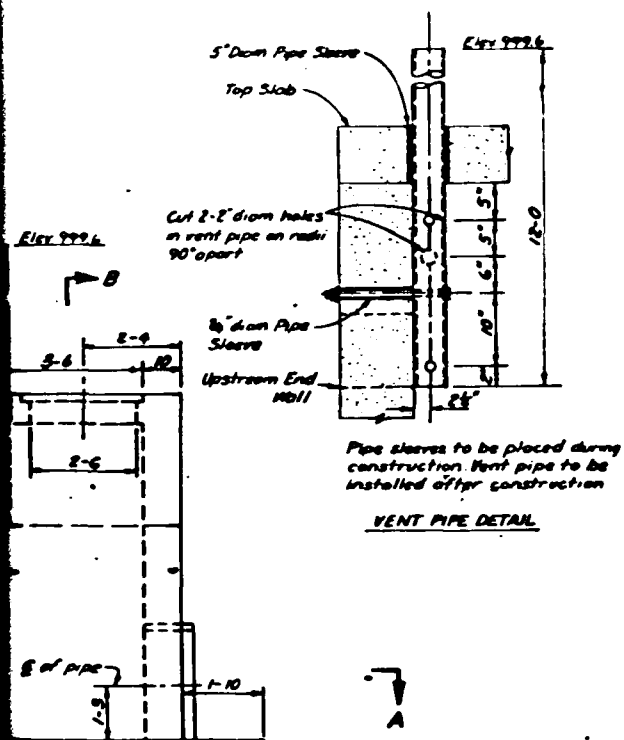
SIDEWALL ELEVATION



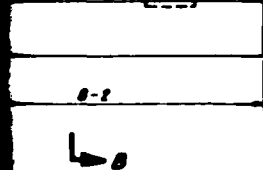
Note: Modify cradle shown on sheet 7 as required to fit between riser footing. Cradle and riser footing shall be separated by 1/4" Bituminous Type preformed expansion joint filler.

SECTION A-A

MATERIAL SCHEDULE - VENT PIPE		
Quantity	Item	Length
1	4" Diam Std Galv Pipe	12'-0"
1	5' Diam Std Galv Pipe Sleeve	0'-8"
3	1/2" Diam Std Galv Pipe Sleeve	0'-10"
3	1/2" Diam Galv Steel Bolts w/ Nut, Lock Washer & 2 Flat Washers	1'-6"



VENT PIPE DETAIL



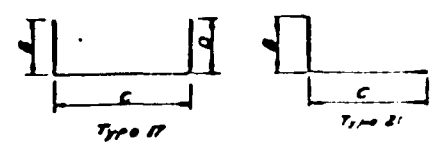
ALL ELEVATION

QUANTITIES

STEEL	
#8 BARS -	841.50 FT. - 562.1 LBS.
#6 BARS -	322.75 FT. - 336.6 LBS.
#4 BARS -	54.00 FT. - 66.1 LBS.
TOTAL	938.8 LBS.
CONCRETE	6.94 CU. YDS.

BAR BENDS

Straight
Type 1



STEEL SCHEDULE

MARK	SIZE	QUANTITY	LENGTH	TOTAL LENGTH	TYPE	B	C
B1	5	8	7'-0"	56'-0"	1		
B2	5	6	1'-0"	7'-0"	1		
B3	5	6	7'-0"	42'-0"	1		
B4	5	6	6'-0"	36'-0"	1		
B5	5	7	7'-0"	49'-0"	1		
B6	5	6	1'-0"	7'-0"	1		
B7	5	4	7'-0"	28'-0"	1		
B8	5	6	6'-0"	36'-0"	1		
B9	5	12	10'-0"	120'-0"	21	7'-4"	3'-0"
B10	5	8	7'-0"	56'-0"	21	7'-4"	0'-0"
B11	5	3	6'-0"	18'-0"	1		
B12	5	10	7'-4"	74'-0"	21	4'-0"	0'-0"
B13	5	4	7'-4"	30'-0"	21	4'-0"	0'-0"
B14	5	3	6'-0"	18'-0"	1		
B15	5	2	6'-3"	12'-6"	21	1'-4"	3'-3"
B16	5	8	6'-4"	51'-2"	21	3'-1"	3'-1"
B17	5	21	6'-3"	132'-3"	1		
B18	5	6	6'-4"	38'-0"	21	1'-1"	3'-3"
B19	4	2	1'-0"	2'-0"	1		
B20	4	2	4'-0"	8'-0"	1		
B21	4	2	4'-0"	8'-0"	1		
T8	5	6	6'-0"	36'-0"	21	3'-0"	3'-3"
T9	5	6	3'-4"	19'-0"	21	2'-0"	0'-0"
T10	5	2	3'-0"	6'-0"	21	2'-0"	1'-0"
T11	5	2	3'-0"	6'-0"	21	1'-0"	1'-3"
T12	5	2	4'-9"	9'-6"	21	2'-9"	2'-0"
T13	5	2	6'-0"	12'-0"	21	2'-9"	3'-3"
T14	5	3	3'-3"	9'-9"	21	2'-1"	0'-4"
T15	5	3	6'-0"	18'-0"	21	3'-0"	3'-3"
T16	5	19	2'-0"	38'-0"	1		
T17	5	2	1'-6"	3'-0"	1		
T18	5	16	6'-4"	102'-4"	21	3'-3"	3'-3"
T19	5	4	4'-6"	18'-0"	21	1'-3"	3'-3"
T20	5	6	6'-0"	36'-0"	1		
T21	5	4	1'-0"	4'-0"	1		
T22	5	5	1'-0"	5'-0"	1		
T23	5	5	6'-0"	30'-0"	1		
T24	5	2	1'-0"	2'-0"	1		
T25	5	2	0'-4"	1'-0"	1		
T26	5	2	0'-9"	1'-6"	1		
T27	5	6	6'-0"	36'-0"	1		
T28	5	5	6'-0"	30'-0"	1		
T29	5	2	0'-4"	1'-0"	1		

* These bars shall be field bent as needed to install the 5" diam pipe sleeve.

AS BUILT Scale in feet

SOUTHWEST CITY STRUCTURE
R/C RESTRICTED FLOW RISER
FOR 30" DIAM R/C PIPE
SOUTHWEST MISSOURI R.C.D. PROJECT
MCDONALD COUNTY, MISSOURI

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed H.R.R.	Date 7-67	Approved by _____
Drawn H.R.R.	Date 7-67	Check _____
Reviewed R.M.K.	Date 7-67	Stamp _____
Checked H.R.R.	Date 7-67	Stamp 65-3204

STRUCTURE DATA

Freeboard Hydr
Rainfall —
Runoff —
Peak Inflow
Maximum Discharge
Maximum Water

Class of Structure "C"
Drainage Area (total) 304 Ac. 0.475 Sq. Mi.
(uncontrolled) 304 Ac. 0.475 Sq. Mi.
Time of Concentration 0.41 Hours
Soil Cover Complex Number 66 For A.M.C. II
*Sediment Capacity Available 9.5 Ac.Ft. below Elev. 987.6
Total Sediment Capacity Available 9.5 Ac.Ft.
Capacity Equivalents (Vol.) 0.38 In.
Retarding Capacity Provided 77.1 Ac.Ft.
Capacity Equivalents (Vol.) 3.04 In.
Water Supply Provided _____ Ac.Ft. - Identify Uses

*100 Yr. Sediment Elev.

Principal Spillway:

Maximum Capacity (low stage) 55* c.f.s.
Maximum Capacity (high stage) _____ c.f.s.
10 Day Drawdown Elev. 987.6

Emergency Spillway:

Percent Channel Use 1 Storm Duration 6
Type Key Earth "n" Value Used 0.04

Emergency Spillway Hydrograph for Class "C" Structures

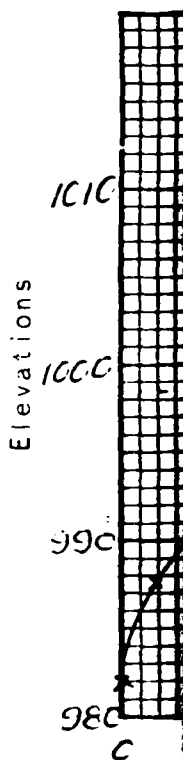
Rainfall 12.1 in.
Runoff 7.55 in.
Peak Inflow 144.3 c.f.s.
Maximum Discharge - Emergency Spillway 502 c.f.s.
Maximum Water Surface Elev. 1000.91
Velocity of Flow (V_e) 5.4 f.p.s.

Supplementary Data and Special Design Features:

Principal Spillway Crest Elev. 987.6
Emergency Spillway Crest Elev. 999.5
Settled Top of Dam Elev. 1004.7
Emergency Spillway Bottom Width 150'

This is a dry dam with an orifice at Elev. 982.6

* Includes approx. 30 c.f.s. discharge through drawdown orifice.



Supplementary
Special Design

H x S = 19 x 86

STRUCTURE DATA

Freeboard Hydrograph for Class "C" Structures

Rainfall 29.00 in.

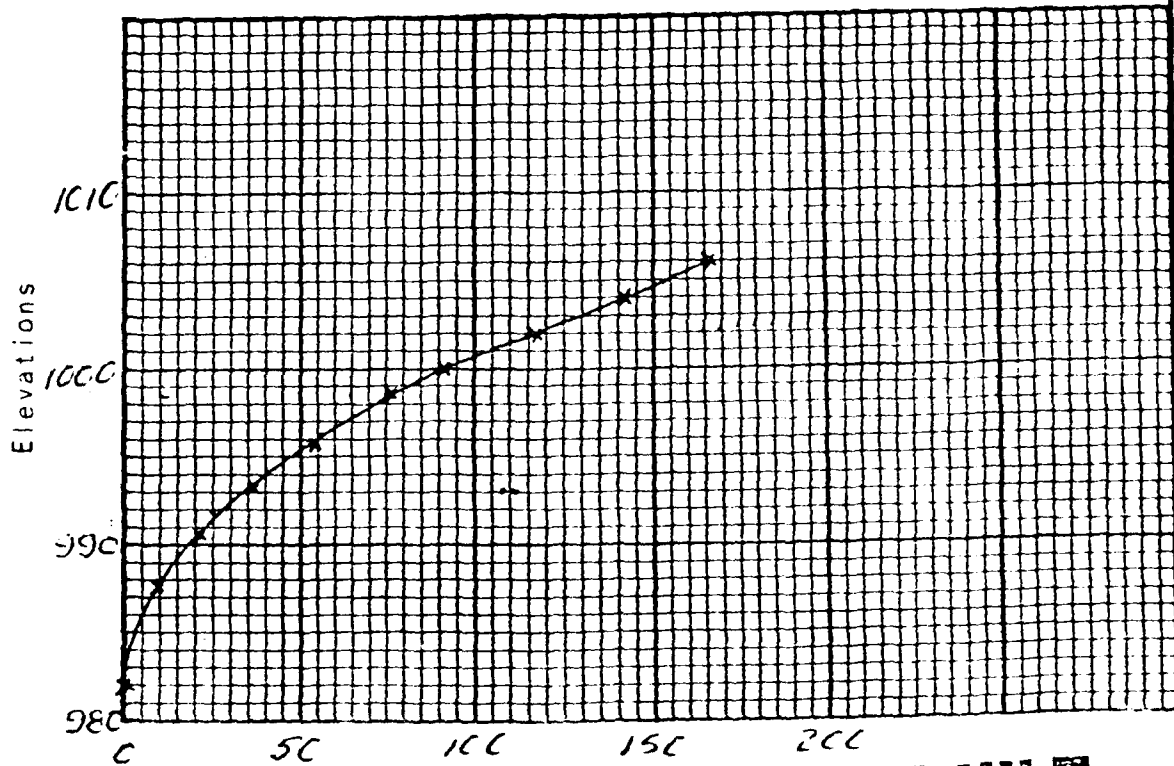
Runoff 23.62 in.

Peak Inflow 4731 c.f.s.

Maximum Discharge - Emergency Spillway 4607 c.f.s.

Maximum Water Surface Elev. 1004.56

Reservoir Capacity



Total Storage - Ac.Ft.

AS BUILT

Supplementary Data and
Special Design Features:

$$H \times S = 19 \times 86.6 = 1645$$

SOUTHWEST CITY STRUCTURE
SOUTHWEST RCD PROJECT
MCDONALD COUNTY, MISSOURI
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed by <u>NAS & R.W.K.</u>	Date <u>1969</u>	Drawn by <u>B.E.S.</u>	Date <u>9-69</u>
Checked by <u>N.H.R. & R.W.K.</u>	Date <u>10-69</u>	Project No. <u>5, E-27,741-E</u>	

Base Drawing 5 E 13 A 2

Sheet 9 of 11

v: 982.6

drawdown orifice.

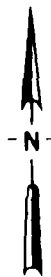
PROJECT	SOUTHWEST MISSOURI R&D	COUNTY	MCDONALD
	SOUTHWEST CITY FP		
MEASURE NAME/NO.	29-6002-119-025	DATE WORK COMPLETED	1971

Signature of Representative (SCS) Harley Spivey Date of Inspection 7/19/67 Signature of Sponsors Bruce Lynch
Representative May

Sheet 10 of Appendix A

APPENDIX B

Geology and Soils



LEGEND

GLACIATED PLAINS



WESTERN PLAINS



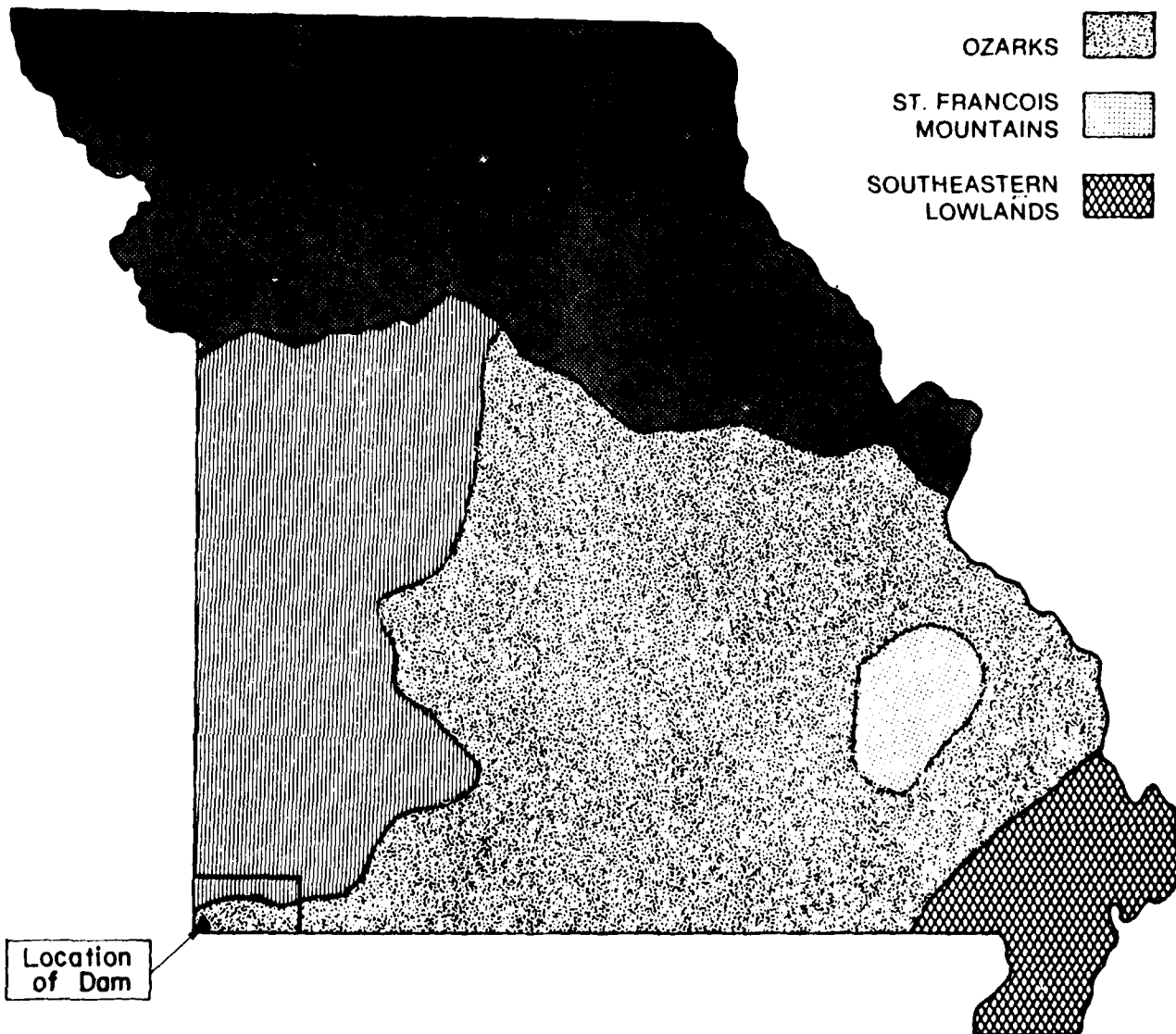
OZARKS



ST. FRANCOIS MOUNTAINS



SOUTHEASTERN LOWLANDS



Location
of Dam

MAJOR GEOLOGIC REGIONS OF MISSOURI

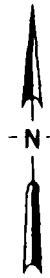


HANSON
ENGINEERS
INCORPORATED

SPRINGFIELD, IL • PEORIA, IL • ROCKFORD, IL

Southwest City Structure
McDonald County, Missouri
Mo. I.D. No. 20510

SHEET 1, APPENDIX B



FEET

20 +



10-20



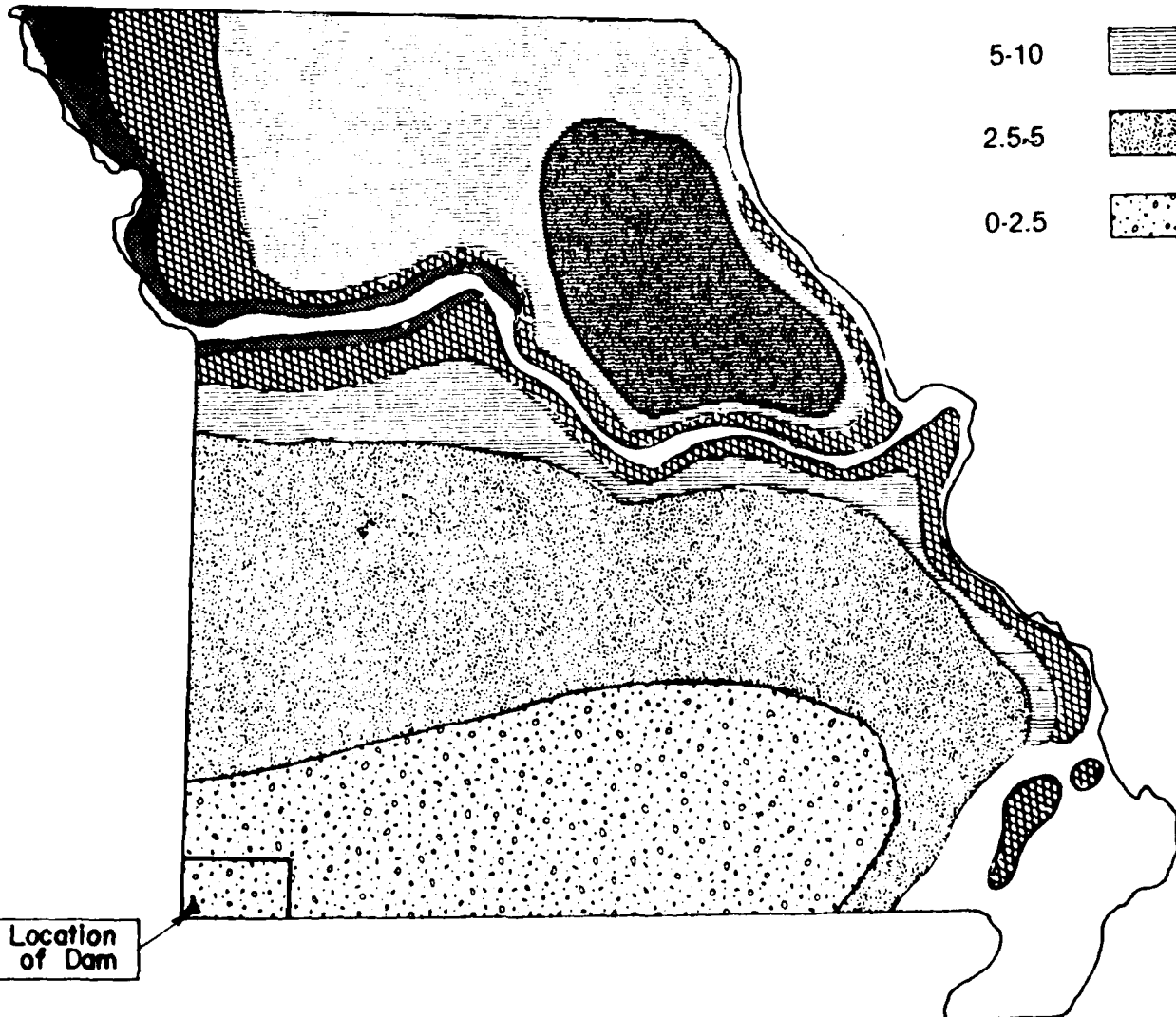
5-10



2.5-5



0-2.5



Location
of Dam

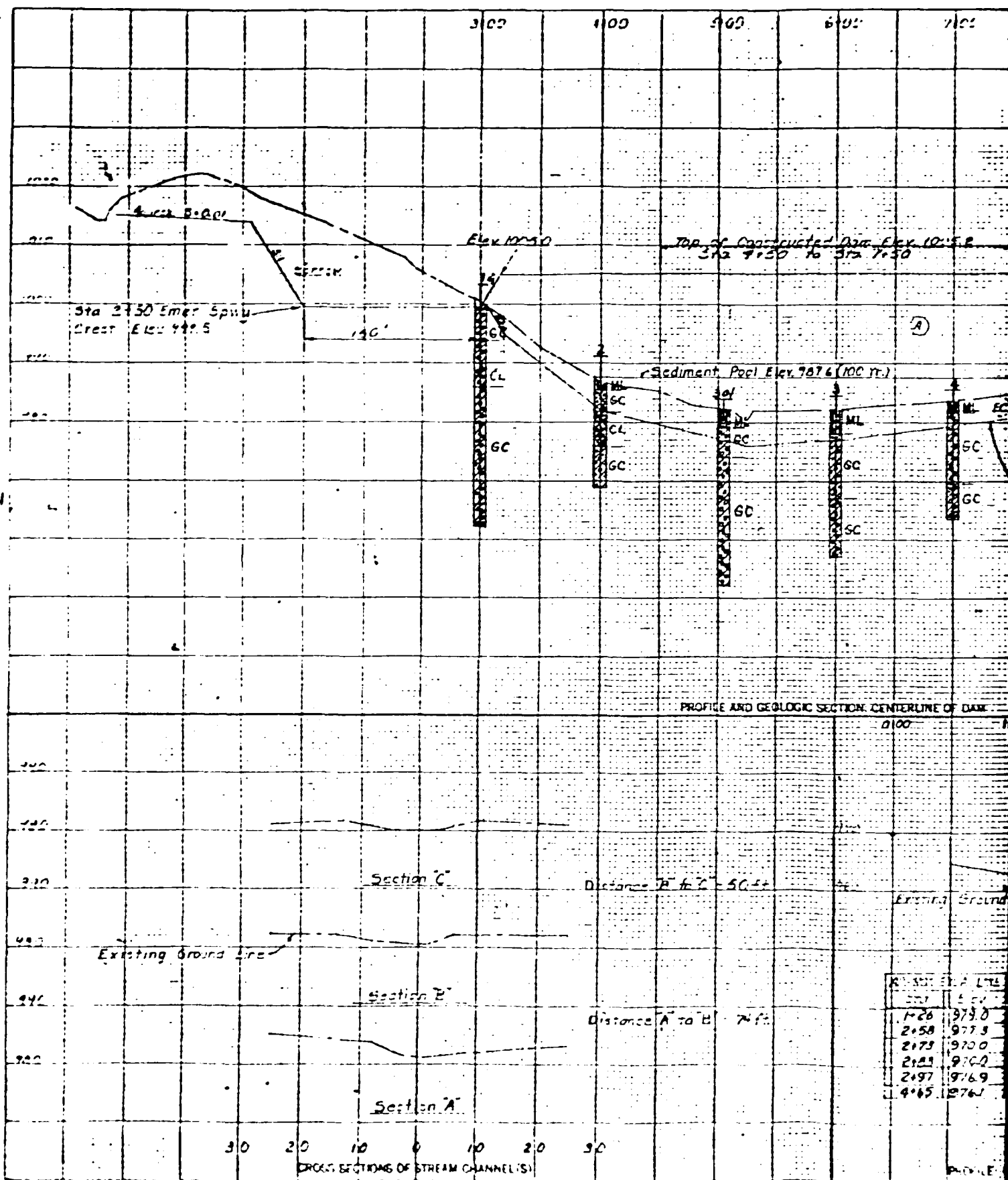
THICKNESS OF LOESSIAL DEPOSITS

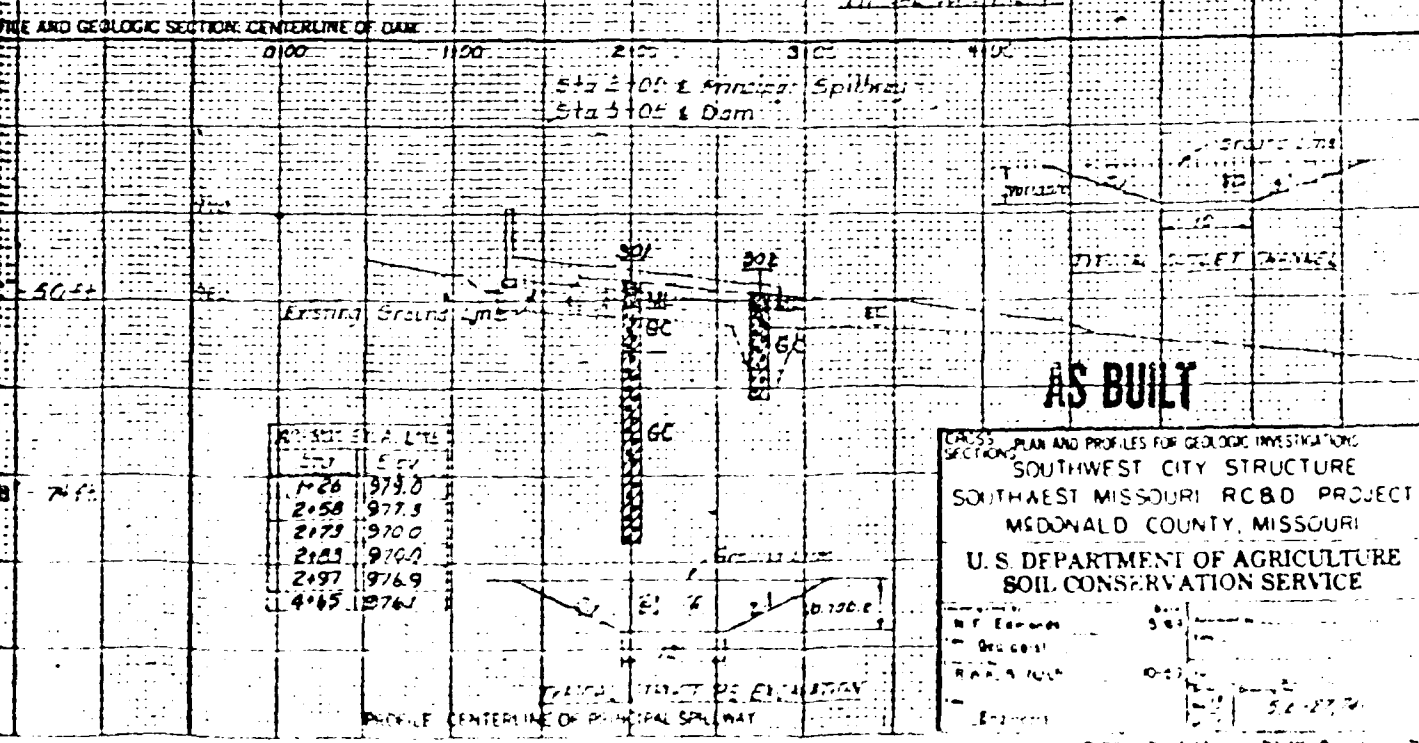
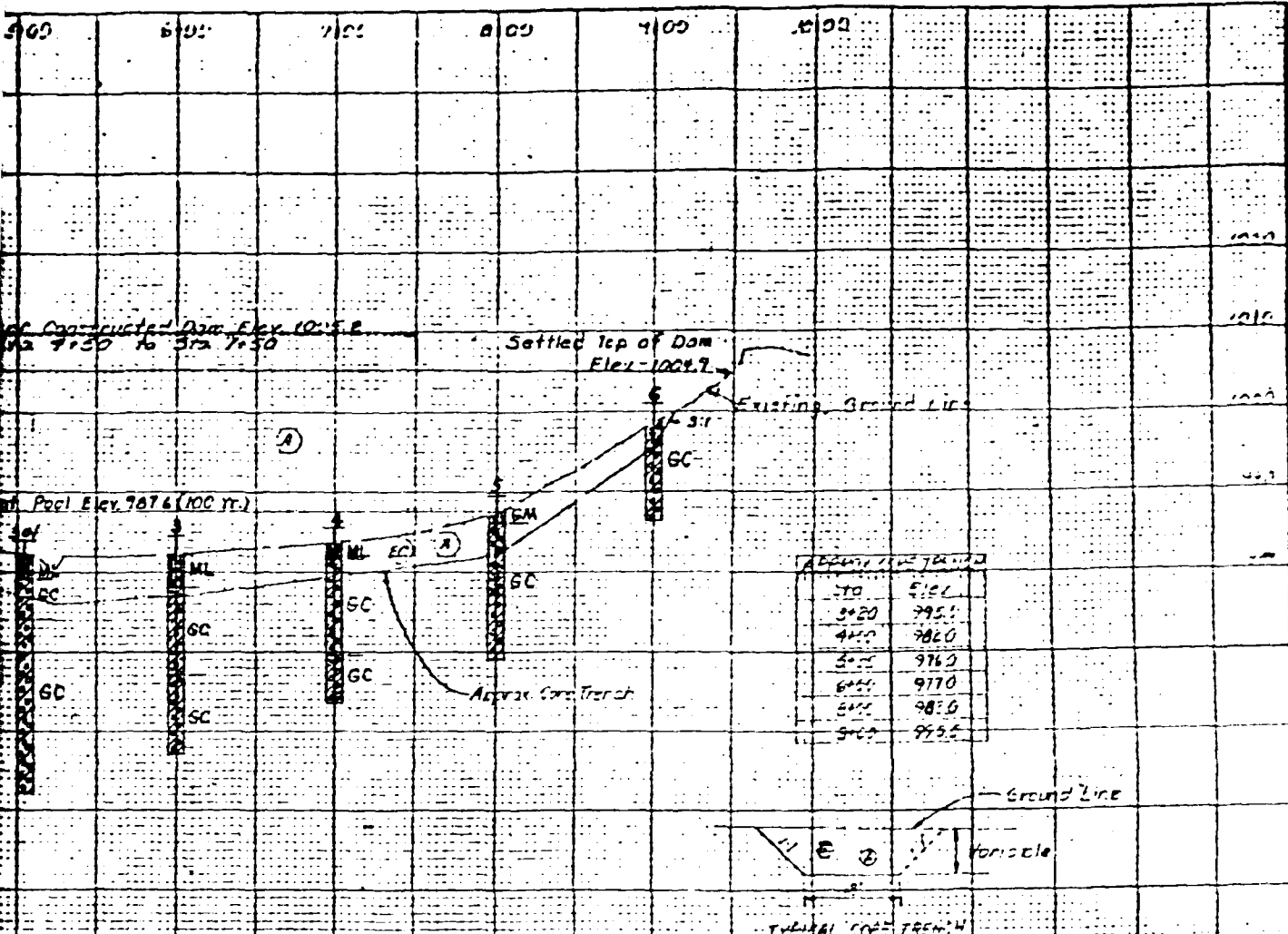


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Southwest City Structure
McDonald County, Missouri
Mo. I. D. No. 20510

SHEET 2, APPENDIX B





UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

DETAILED GEOLOGIC INVESTIGATION OF DAM SITES

GENERAL

State Missouri County McDonald NW $\frac{1}{4}$ SW $\frac{1}{4}$ 33 23N 34W
NE $\frac{1}{4}$ SE $\frac{1}{4}$ 3 T23N R 25E ; Watershed RC&D-2
Subwatershed So. W. City Ely class 6002 Site number SW-1 Site group I Structure class C
(FP-2, WP-1, etc.)
Investigated by M. J. Blum Equipment used Falling 1500 Date 5/23/69
(signature and title) (Type, size, make, model, etc.)

SITE DATA

Drainage area size 304 sq. mi., 304 acres. Type of structure D. I. Purpose FWR
Direction of valley trend (downstream) N Maximum height of fill 25 feet. Length of fill 650 feet.
Estimated volume of compacted fill required 35,000 yards

STORAGE ALLOCATION

	Volume (ac. ft.)	Surface Area (acres)	Depth at Dam (feet)
Sediment	<u>9.5</u>	<u>3.0</u>	
Floodwater	<u>86.5</u>	<u>10.3</u>	

SURFACE GEOLOGY AND PHYSIOGRAPHY

Physiographic description Ozark Highland Topography Rolling Altitude of beds: Dip - Strike -
Steepness of abutments: Left 13 percent Right 11 percent. Width of floodplain at centerline of dam 150 feet
General geology of site: The site is located in National Soil Resource area 116, The Ozark Highland. The residual overburden consists of varying amounts of chert and clay. The residuum is weathered from cherty limestones of the Osagean Series, Mississippian System. The depth to unweathered bedrock was not determined.

DETAILED GEOLOGIC INVESTIGATION OF DAM SITES

FEATURE E of Dam, Principal Spillway, Emergency Spillway, borrow, channel

(CENTERLINE OF DAM, PRINCIPAL SPILLWAY, EMERGENCY SPILLWAY, THE STREAM CHANNEL, INVESTIGATIONS FOR DRAINAGE OF STRUCTURE, BORROW AREA, RESERVOIR BASIN, ETC.)

DRILLING PROGRAM

EQUIPMENT USED	NUMBER OF HOLES		NUMBER OF SAMPLES TAKEN		
	EXPLORATION	SAMPLING	UNDISTURBED (STATE TYPE)	LARGE	SMALL
5" Flight Auger	14				
Backhoe		3		4 bag	1 bag
TOTAL	14	3		4	1

SUMMARY OF FINDINGS
(INCLUDE ONLY FACTUAL DATA)

The abutments are residual chert with varying amounts of clay which also occurs beneath the material described as alluvial - colluvial in the valley floor. This material forms the foundation for the principal spillway. The emergency spillway cuts will be in the residual overburden. Bedrock was not encountered in any of the test holes. No water table was observed in any of the test holes. There is a dug well 10 feet left of centerline station 3+10 and a cased well 5 feet left of centerline station 2+90. The water level in the cased well was below 100 feet.

DETAILED GEOLOGIC INVESTIGATION OF DAM SITES

WATERSHED RC&D-2		SUBWATERSHED Southwest City		COUNTY Mc Donald	STATE Missouri
SITE NO. McSW-1	SITE GROUP 1	STRUCTURE CLASS C	INVESTIGATED BY: (SIGNATURE OF GEOLOGIST) <i>William J. Schaeffer</i>		DATE 5/23/69

INTERPRETATIONS AND CONCLUSIONS

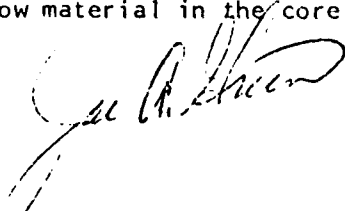
The material of the valley floor described as alluvial-colluvial and classified GC is believed very permeable. This material was sampled for classification. All residual material of the foundation is classified as similar to the materials of the borrow areas. Samples were taken from two backhoe pits and are as representative as possible. Field classification of the material is similar and it is believed that composite samples, 101.1 w/102.1 and 101.2 w/102.2, will be representative. In the emergency spillway and borrow areas the thickness and sequence of the layers which are predominately chert and the amount of clay is variable. Generally the upper two feet has less chert and is classified CL. The chert zones are fractured and weathered and believed possible to be moved with a blade or ripper. The strata with clay, classified GC, contain variable amounts of chert which is weathered and may breakdown some during borrowing and compacting. The material of the borrow areas and emergency spillway was dry in the upper part to only slightly moist with depth. The dry or low moisture content of the borrow material is expected to exist during normal construction seasons. Water was not encountered in any of the test holes. Three channel sections were investigated and the material found to be similar to the residuum of the foundation.

ENGINEER'S REPORT

May 23, 1969

Southwest Missouri RC&D Project
Southwest City Floodwater Control Structure

1. Stream channel cleanout - Due to similarity of material through the floodplain, no stream channel cleanout is recommended for this site.
2. Core - The foundation area at the site is mostly sand and gravel throughout. This sand and gravel was logged to approximately 15 ft. deep. As this will be a dry structure, it is recommended that the core be from 4 to 6 feet deep across the valley floor.
3. Foundation area - There are no large amounts of undesirable material in the foundation area. Top soil should be stripped and stockpiled for placing on the embankment.
4. Borrow area - The excavation of emergency spillway should be used in the embankment. This will amount to approximately 15,000 yards. Approximately 20,000 additional yards should be obtained by flattening off the top of the ridges north and east of emergency spillway including South street and the north-south State line road. Top soil should be salvaged from entire area and stockpiled for covering embankment, emergency spillway area and adjacent areas. After removal of top soil approximately 1 to 2 feet of clay material relatively free of chert should be available. This material should be used for the center section of the embankment. The remaining needed material should be obtained from 2 to 6 feet deep from the borrow area. This area has considerable chert with some red clay layers. The embankment should be constructed by selected placement during construction operations.
5. Conduit - The principal spillway will be concrete pipe 30" in diameter with a 60 cfs release rate.
6. Drainage - Soils of the area are very permeable and no special drainage problems are expected.
7. Laboratory recommendations - Need recommendations on placement of available borrow material in the core and embankment.



UNITED STATES GOVERNMENT

*Memorandum*U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

TO : James M. Dale, State Conservation Engineer,
SCS, Columbia, Missouri

DATE: August 25, 1969

FROM : Lorn P. Dunnigan, Head, Soil Mechanics Laboratory,
SCS, Lincoln, Nebraska

SUBJECT: ENG 22-5, Missouri RC&D, Southwest City Lake, Site Mc SW-1 (McDonald County)

ATTACHMENTS

1. Form SCS-354, Soil Mechanics Laboratory Data, 1 sheet.
2. Form SCS-352, Compaction and Penetration Resistance, 2 sheets.

DISCUSSIONFOUNDATION

- A. Classification: The soil on the abutments is a residual chert with varying amounts of clay. This material is classed primarily as GC although there is one zone of CL logged in test hole No. 1 on the left abutment.

About 10 to 12 feet of alluvium-colluvium overlies the residual material in the floodplain section. The alluvium-colluvium is logged as GC, and a sample submitted is classed GC-GM. It is reported that the alluvium-colluvium soil is expected to be quite permeable.

No water table was encountered during the investigation. It was noted, however, that the water level was below 100 feet in a cased well 5 feet left of station 2+90.

- B. Shear Strength: The shear strength is expected to be high, and the consolidation potential is expected to be low for both residual material and the alluvial-colluvial material.

EMBANKMENT

- A. Classification: The source of borrow material is outlined in the field engineer's report. The samples submitted from the 0.5 to 2.0-foot depth are classed as CL and ML. They contain about 40 percent gravel and slightly over 50 percent fines. The material below 2 feet is slightly coarser grained. It contains about 45 percent gravel and 45 percent fines. The samples submitted are classed as GM, but the liquid limits and PI's are in the range of 60 and 20, which is considerably higher than those of the surface material. You will also note the percent of material finer than 0.005 mm. is considerably higher in the GM material than in the surface zone of material.

James M. Dale

2

Subj: ENG 22-5, Missouri RC&D, Southwest City Lake, Site Mc SW-1

- B. Compacted Density: The CL and the ML were composited and the two GM samples were composited for compaction tests, as requested. Standard Proctor compaction tests (ASTM D-698, Method C) were made on the fraction finer than 3/4 inch. The maximum dry densities obtained are 103.5 pcf on the CL and ML mix and 87.5 pcf on the GM composite.
- C. Shear Strength and Slope Stability: With compaction to 95 percent of Proctor, the shear strength of these materials will be adequate for the slopes planned.

RECOMMENDATIONS

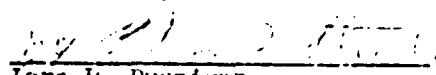
- A. Cutoff: It was pointed out that the alluvial-colluvial material is expected to be quite permeable. If this material is stratified, we suggest that the core trench bottom in the residual material in the floodplain and at a depth of about 6 feet in the abutments. If the alluvium-colluvium is non-stratified, then a trench depth of about 6 feet will be adequate for the valley floor as well.

We suggest you use the finer grained material for backfill and compact it to a density of about 95 percent of Proctor with the control on the minus 3/4-inch fraction.

- B. Principal Spillway: The consolidation potential of the foundation is expected to be quite low for the fill height planned.
- C. Drain: As pointed out in the field engineer's report, the soils of this area are very permeable and drains are not considered necessary with the cutoff trench suggested.
- D. Embankment Design:

1. Placement of Materials: We suggest that materials like those sampled be placed at a density of about 95 percent of standard Proctor with the control based on the minus 3/4-inch fraction. We suggest a moisture content slightly wet of standard Proctor optimum to obtain as low a permeability rate as possible. In addition we suggest that the fine-grained materials be routed to the central section of the fill with the coarser grained material placed in the outer sections. The intent here is to use the material in the center section that will end up with the most uniform density.
2. Slopes: No problems are anticipated with the 2 1/2:1 slopes planned.
3. Settlement: An overfill allowance of 0.5 foot is suggested to compensate for residual consolidation in the fill and foundation.

Prepared by:


Iorn P. Dunnigan

cc:

James M. Dale
Joe A. Green, Mt. Vernon, Mo.
E. D. Butler, Lincoln, Nebr.

Sheet 9 of Appendix B

Attachments

35,000 cy

Class "C"
Hloodwater

[illegible]

MATERIALS TESTING REPORT U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE **COMPACTION AND PENETRATION RESISTANCE**

PROJECT and STATE

McDonald Co. Site: MC SW-1, Missouri

FIELD SAMPLE NO.

*

LOCATION

Composite - Mix #1X

DEPTH

1.5-2.1

GEOLOGIC ORIGIN

TESTED AT

SAL-LINCOLN

APPROVED BY

LPD

DATE

CLASSIFICATION LL PI

CURVE NO. 1X OF 2

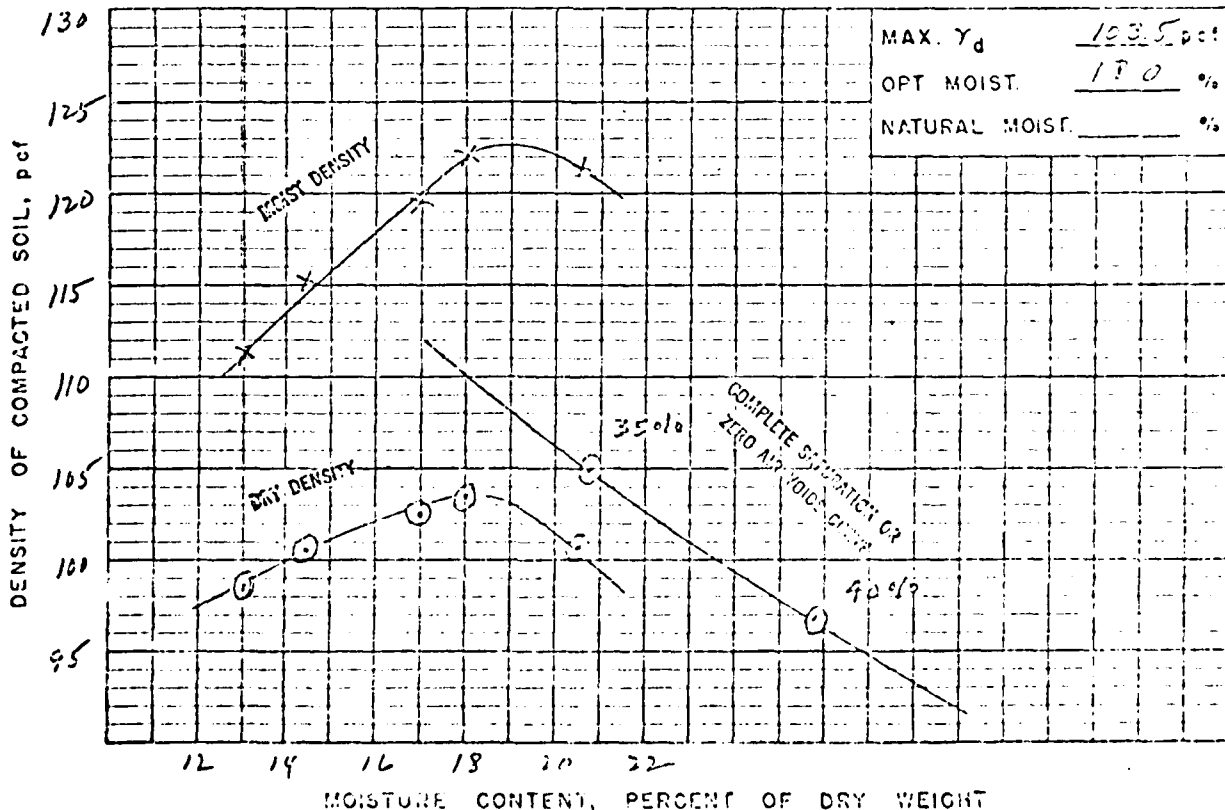
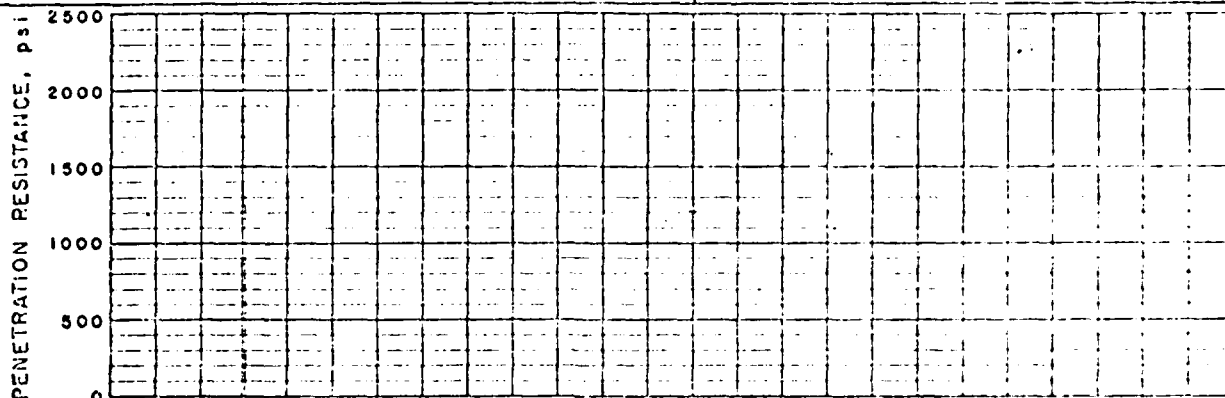
MAX. PARTICLE SIZE INCLUDED IN TEST 2 3/4"

STD. (ASTM D-698) ☒ METHOD C

SPECIFIC GRAVITY (G_s) { MINUS NO. 4 2.59
PLUS NO. 4

MOD. (ASTM D-1557) ☐ METHOD

OTHER TEST ☐ (SEE REMARKS)



MAX. γ_d 103.5 pcf
OPT. MOIST. 18.0 %
NATURAL MOIST. %

REMARKS

CURVE IS FOR THE MINUS NO. 4 FRACTION
GRADATION OF TOTAL SAMPLE

< NO. 200 % < NO. 4 % < IN. 3 Sheet 11 of Appendix B

MATERIALS TESTING REPORT U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE **COMPACTION AND PENETRATION RESISTANCE**

PROJECT STATE Mo. SW-1 Co. site: MSW-1, Missouri.

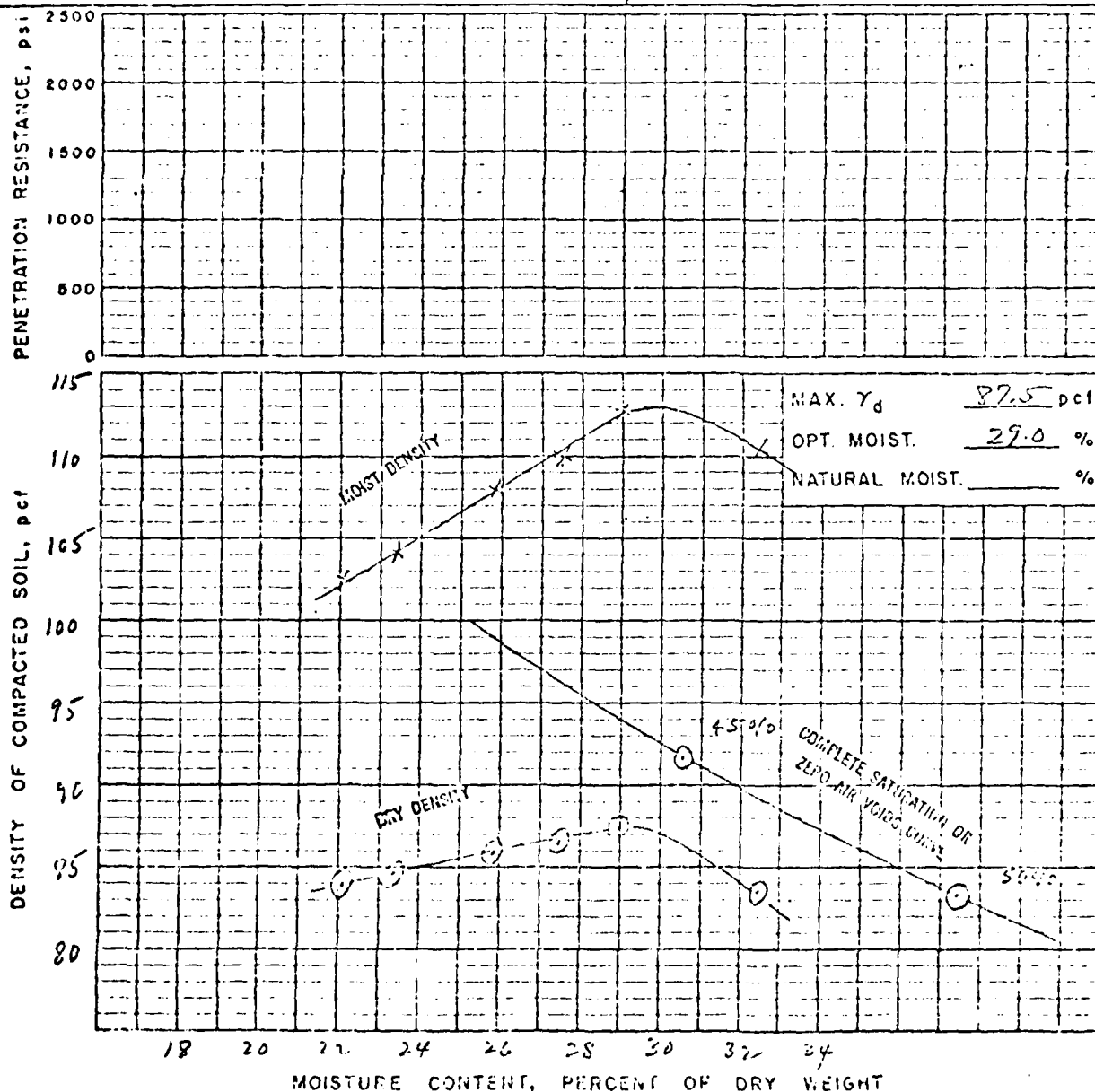
FIELD SAMPLE NO. 1 LOCATION Composite - Mix # 2-X DEPTH 2-6'

GEOLOGIC ORIGIN _____ TESTED AT SML-LINCOLN APPROVED BY LPD DATE _____

CLASSIFICATION _____ LL _____ PI _____ CURVE NO. 2-X OF 2

MAX. PARTICLE SIZE INCLUDED IN TEST 2.36 " STD (ASTM D-698) ☒ METHOD C

SPECIFIC GRAVITY (G_s) { MINUS NO. 4 2.67 MOD (ASTM D-1557) ☐ METHOD _____
PLUS NO. 4 _____ OTHER TEST ☐ (SEE REMARKS)



REMARKS

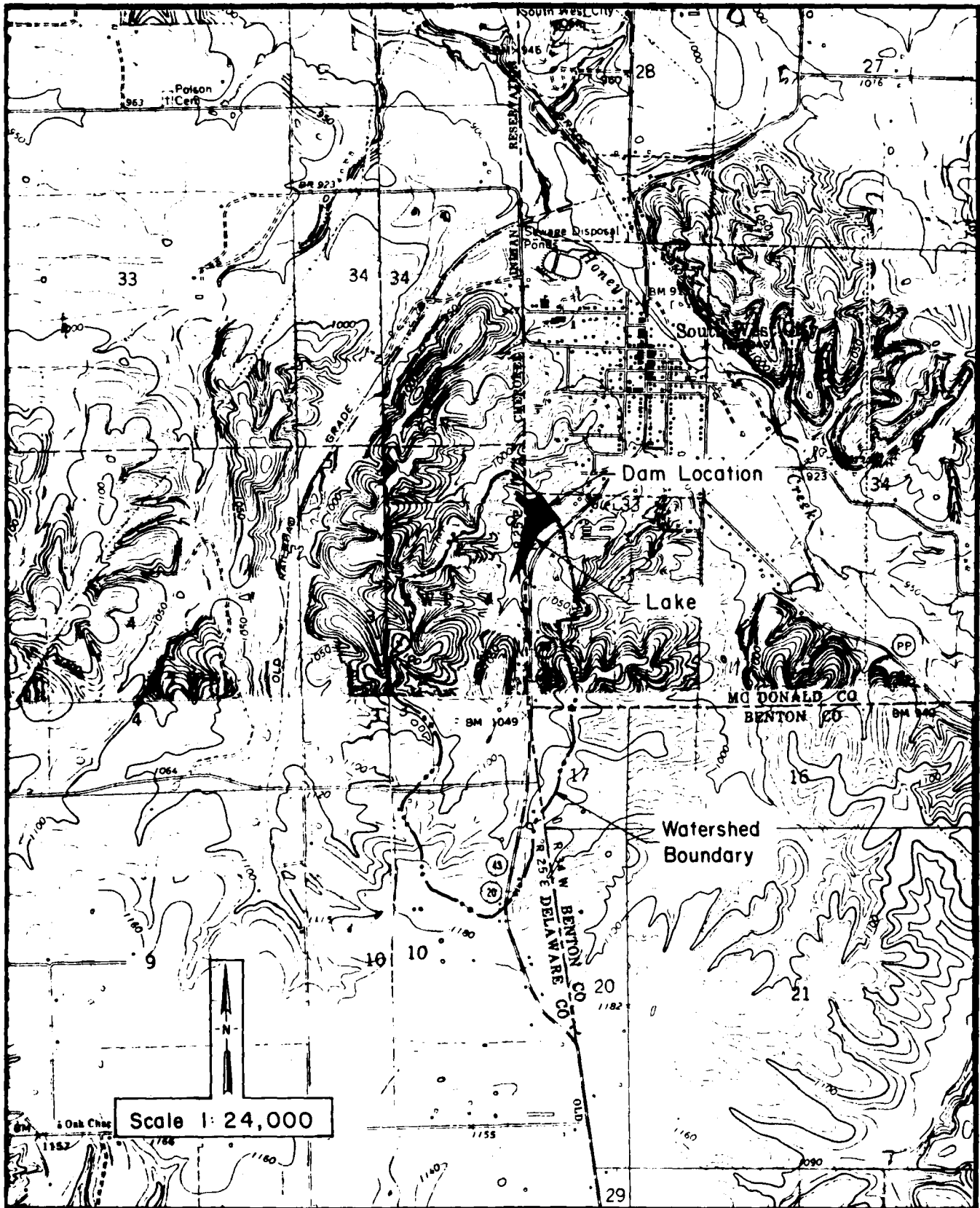
ADJUSTED FOR THE MINUS NO. 4 FRACTION
CRUSHED OF TOTAL SAMPLE

- No. 200 3, - No. 4 17, - IN. 9

Sheet 12 of Appendix B

APPENDIX C

Overtopping Analysis



LAKE AND WATERSHED MAP



SPRINGFIELD, IL • PEORIA, IL • ROCKFORD, IL

South West City Structure E-1 Dam
McDonald County, Missouri
Mo. I. D. No. 20510

Sheet 1, Appendix C

APPENDIX C

HYDROLOGIC AND HYDRAULIC ANALYSIS

To determine the overtopping potential, flood routings were performed by applying the Probable Maximum Precipitation (PMP) to a synthetic unit hydrograph to develop the inflow hydrograph. The inflow hydrograph was then routed through the reservoir and spillway. The overtopping analysis was accomplished using the systemized computer program HEC-1 (Dam Safety Version), July 1978, prepared by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, California.

The PMP was determined from regional charts prepared by the National Weather Service in "Hydrometeorological Report No. 33." Reduction factors were not applied. The rainfall distribution for the 24-hour PMP storm duration was assumed according to the procedures outlined in EM 1110-2-1411 (SPD Determination).

The synthetic unit hydrograph for the watershed was developed by the computer program using the SCS method. The parameters for the unit hydrograph are shown in Table 1 (Sheet 4, Appendix C).

The SCS curve number (CN) method was used in computing the infiltration losses for rainfall-runoff relationship. The CN values used, and the result from the computer output, are shown in Table 2 (Sheet 5, Appendix C).

The reservoir routing was accomplished by using the Modified Puls Method. The hydraulic capacity of the spillway was used as an outlet control in the routing. The hydraulic capacity of the spillway and the storage capacity of the reservoir were defined by the elevation-surface area--storage-discharge relationships shown in Table 3 (Sheet 5, Appendix C). This dam has been designed for flood control purposes, and the water surface elevation is maintained below the primary spillway invert elevation. To consider the effect of the reservoir storage, an antecedent storm of 25 percent and 50 percent of the PMF was considered (assuming the reservoir at the sedimentation pool elevation 987.7) to determine the starting reservoir elevation for the routing of 50 percent and 100 percent of the PMF respectively. The antecedent storms were assumed to occur four days prior to their corresponding storm. Both antecedent storms will fill the reservoir beyond the emergency spillway level, but at the end of the four days, the reservoir will reduce to the sedimentation pool level since the primary spillway is unregulated. Thus, the final routing analysis was accomplished considering the starting reservoir level at the primary spillway invert elevation 987.7 (sedimentation pool).

The results of the routings of the PMF ratios indicate that the dam will pass the 1 percent probability flood without overtopping the dam.

The rating curve for the spillways (see Table 4 Sheet 6, Appendix C) was determined assuming orifice flow for the primary spillway and channel flow for the emergency spillway.

The flow over the crest of the dam during overtopping was determined using the non-level dam option (\$L and \$V cards) of the HEC-1 program; the program assumes critical flow over a broad-crested weir.

A summary of the routing analysis for different ratios of the PMF is shown in Table 5 (Sheet 7, Appendix C).

The computer input data, a summary of the output data, and a plot of the inflow-outflow hydrograph for the PMF are presented on Sheets 8, 9 and 10 of Appendix C.

TABLE 1
SYNTHETIC UNIT HYDROGRAPH

Parameters:

Drainage Area (A)	0.475 sq. miles
Length of Watercourse (L)	1.3 miles
Difference in elevation (H)	198 feet
Time of concentration (Tc)	0.41 hours
Lag Time (Lg)	0.25 hours
Time to peak (Tp)	0.29 hours
Peak Discharge (Qp)	793 c.f.s.
Duration (D)	5 min.

<u>Time (Min.)(*)</u>	<u>Discharge (cfs)(*)</u>
0	0
5	139
10	477
15	759
20	759
25	591
30	354
35	220
40	143
45	89
50	56
55	35
60	22
65	14
70	9
75	6
80	3
85	1

(*) From the computer output

FORMULA USED:

$$T_c = \left(\frac{11.9 L^3}{H} \right)^{0.385}$$

$$L_g = 0.6 T_c$$

$$T_p = \frac{D}{2} + L_g$$

$$Q_p = \frac{484 A \cdot Q}{T_p} \quad Q = \text{Excess Runoff} = 1 \text{ inch}$$

TABLE 2
RAINFALL-RUNOFF VALUES

<u>Selected Storm Event</u>	<u>Storm Duration (Hours)</u>	<u>Rainfall (Inches)</u>	<u>Runoff (Inches)</u>	<u>Loss (Inches)</u>
PMP	24	36.00	33.55	2.45

Additional Data:

- 1) Soil Conservation Service Soil Group B
- 2) Soil Conservation Service Runoff Curve CN = 82 (AMC III) for the PMF
- 3) Soil Conservation Service Runoff Curve CN = 66 (AMC II) for the
1 percent probability flood
- 4) Percentage of Drainage Basin Impervious 2 percent

TABLE 3
ELEVATION, SURFACE AREA, STORAGE AND DISCHARGE RELATIONSHIPS

<u>Elevation (feet-MSL)</u>	<u>Lake Surface Area (acres)</u>	<u>Lake Storage (acre-ft)</u>	<u>Spillway Discharge (cfs)</u>
-	0	0	-
*987.7	3.2	9.8	0
990.0	3.9	18	12
994.0	7.1	40	20
999.5	10.3	87	28
1002	13.0	117	1413
**1004.8	13.8	152	5178
1006.0	-	166	7429
1007.0	-	178	-
1010.0	25.0	272	-

*Primary spillway crest elevation

**Top of dam elevation

The above relationships were developed using data from the SCS plans and the South West City, MO. 7.5 minute quadrangle map.

TABLE 4

SPILLWAYS RATING CURVE

<u>Reservoir Elevation</u>	<u>Primary Spillway (c.f.s.)</u>	<u>Emergency Spillway (c.f.s.)</u>	<u>Total Discharge (c.f.s.)</u>
987.7	0	0	0
990.0	12	0	12
995.0	22	0	22
999.5	28	0	28
1000.0	28	86	114
1000.5	29	285	314
1001.0	29	572	601
1001.5	30	915	945
1002.0	30	1383	1413
1003.0	31	2505	2536
1004.0	32	3885	3917
*1004.8	33	5145	5178
1005.5	34	6420	6454
1006.0	34	7395	7429

*Top of dam elevation

METHOD USED:

- 1) Primary Spillway: assuming orifice flow

$$Q = C.A.(2g.h)^{1/2}$$

Q = Discharge in c.f.s.

C = Discharge coefficient = 0.60

A = Opening area in ft² (10" x 24")

g = Acceleration of gravity = 32.2 ft/sec²

h = Head from reservoir elevation to the center of the opening (in ft)

- 2) Emergency Spillway: Assuming open channel flow.

Using charts from "UD Method of Reservoir Flood

Routing", S.C.S. Technical Release No. 35, February 1967.

TABLE 5
RESULTS OF FLOOD ROUTINGS

Ratio of PMF	Peak Inflow (CFS)	Peak Lake Elevation (ft.-MSL)	Total Storage (AC.-FT.)	Peak Outflow (CFS)	Depth (ft.) Over Top of Dam
-	0	*987.7	10	0	-
0.20	1042	1001.0	105	591	-
0.30	1563	1001.8	115	1280	-
0.40	2084	1002.3	121	1795	-
0.50	2605	1002.8	127	2284	-
0.60	3127	1003.2	132	2789	-
0.70	3648	1003.6	136	3294	-
0.80	4169	1003.9	141	3782	-
0.90	4690	1004.2	145	4292	-
1.00	5211	1004.6	149	4794	-

**1004.8

The dam and spillways will be capable of holding and passing 100 percent of the PMF without overtopping the dam.

*Primary spillway crest elevation

**Top of dam elevation

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
 FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
 AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS								
				RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7	RATIO 8	RATIO 9
HYDROGRAPH AT	1	0.47	1	1042.	1563.	2084.	2605.	3127.	3648.	4169.	4690.	5211.
	(	1.23)	(	29.51)	(44.27)	(59.02)	(73.78)	(88.54)	(103.29)	(118.05)	(132.80)	(147.56)
ROUTED TO	2	0.47	1	591.	1280.	1795.	2284.	2789.	3294.	3782.	4292.	4794.
	(	1.23)	(	16.75)	(36.24)	(50.83)	(64.67)	(78.96)	(93.26)	(107.10)	(121.54)	(135.74)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1						
ELEVATION		INITIAL VALUE	SPILLWAY CREST	TOP OF DAM		
STORAGE		987.70	987.70	1004.80		
OUTFLOW		10.	10.	152.		
		0.	0.	5178.		
RATIO	MAXIMUM	MAXIMUM	MAXIMUM	DURATION	TIME OF	TIME OF
OF	RESERVOIR	DEPTH	STORAGE	OVER TOP	MAX OUTFLOW	FAILURE
PMF	U.S.ELEV	OVER DAM	AC-FT	HOURS	HOURS	HOURS
0.20	1000.98	0.00	105.	0.00	16.08	0.00
0.30	1001.84	0.00	115.	0.00	15.92	0.00
0.40	1002.34	0.00	121.	0.00	15.92	0.00
0.50	1002.78	0.00	127.	0.00	15.92	0.00
0.60	1003.18	0.00	132.	0.00	15.92	0.00
0.70	1003.55	0.00	136.	0.00	15.92	0.00
0.80	1003.90	0.00	141.	0.00	15.92	0.00
0.90	1004.24	0.00	145.	0.00	15.92	0.00
1.00	1004.56	0.00	149.	0.00	15.92	0.00

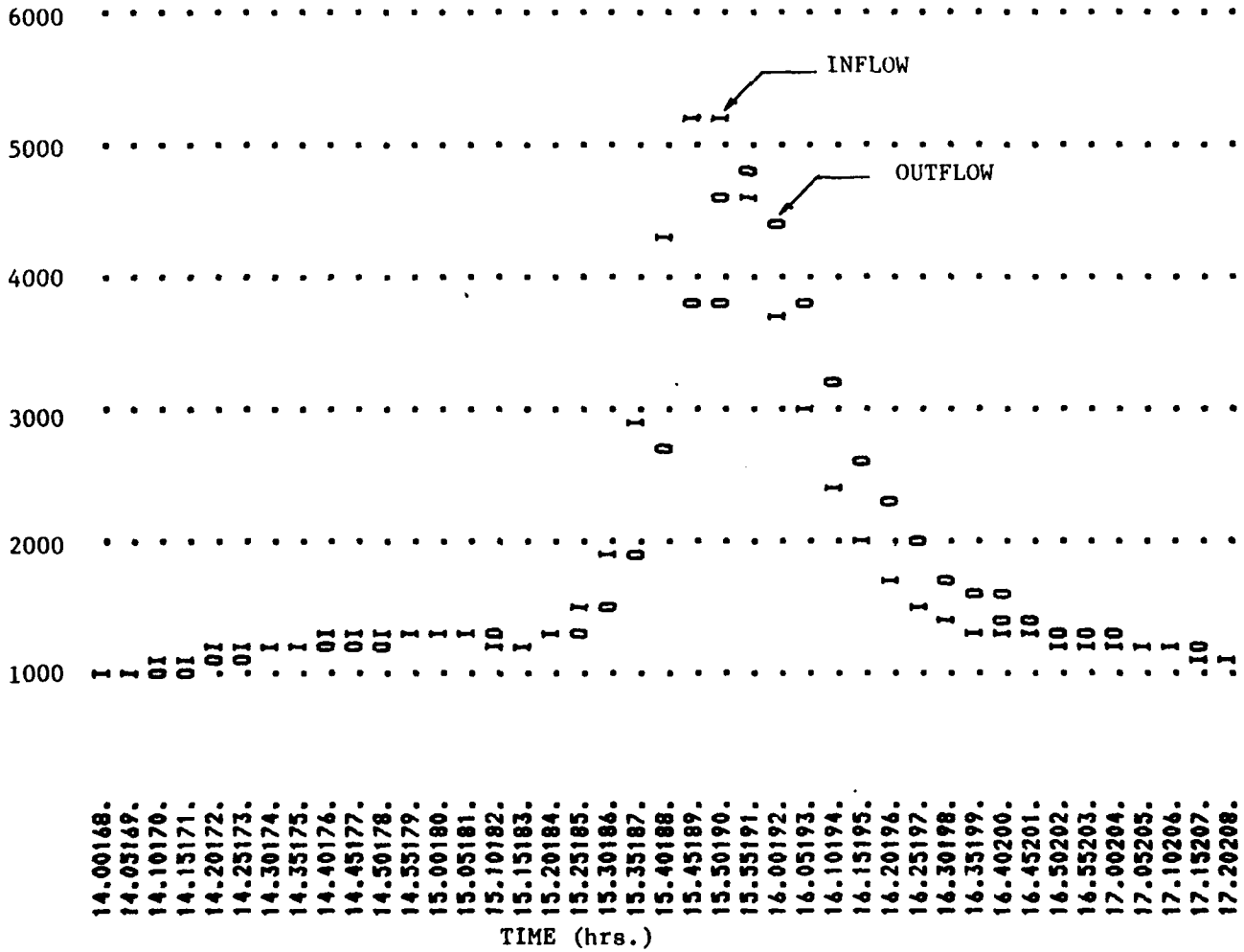
PNF Ratios
Output Data

PMF Ratios
 Output Data

INFLOW-OUTFLOW
HYDROGRAPH
FOR THE PMF

DISCHARGE (c.f.s.)

MAX. INFLOW = 5211 c.f.s.
MAX. OUTFLOW = 4794 c.f.s.



APPENDIX D

Photographs

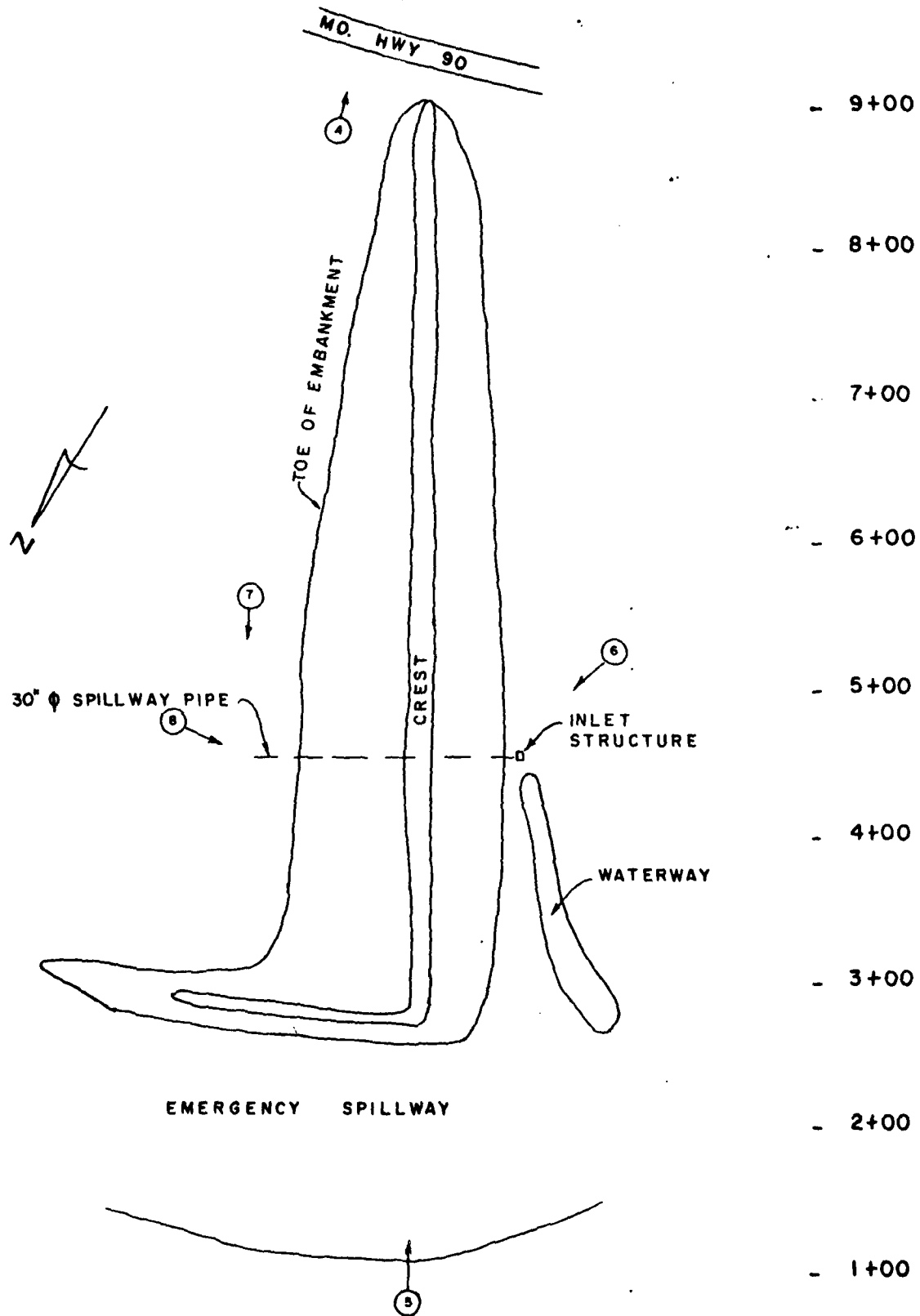
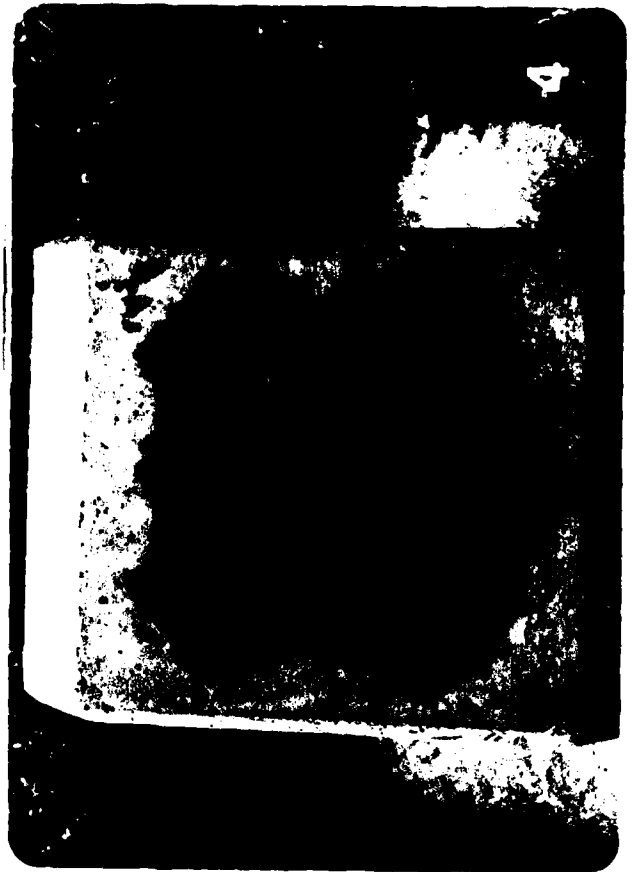
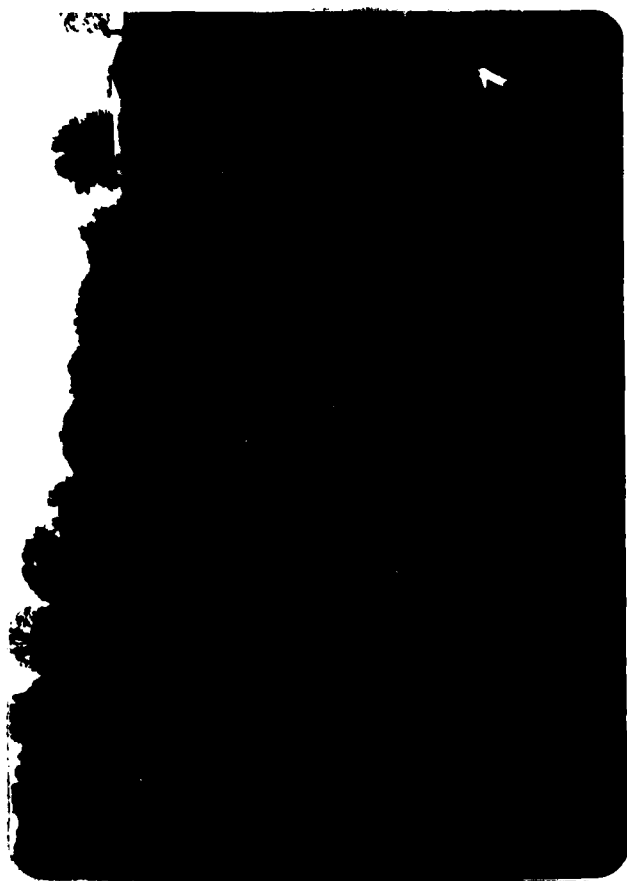
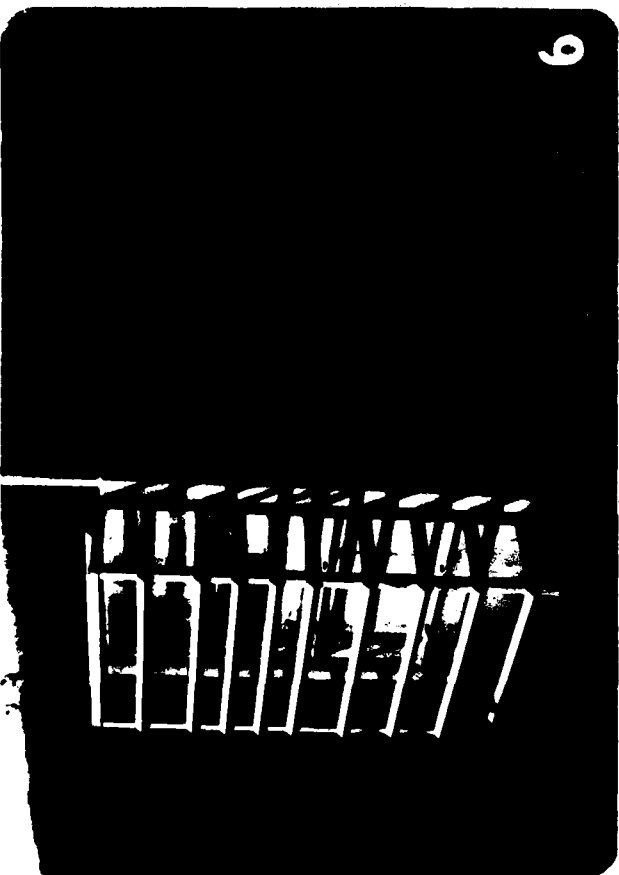


PHOTO INDEX
SOUTHWEST CITY STRUCTURE
MO. No. 20510

LIST OF PHOTOGRAPHS

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1	Aerial View of Embankment
2	Aerial View of Embankment
3	Aerial View Downstream of Dam
4	Closeup of Plaque
5	View of Embankment Crest (Looking South)
6	Closeup of Inlet Structure (Looking North)
7	View of Spillway Outlet (Looking North)
8	View of Spillway Pipe (Looking Southwest)





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